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Y-12: Poster child for a dysfunctional nuclear weapons complex

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In early June 1995, while I visited the Y-12 nuclear weapons plant in Oak Ridge, Tennessee, a small aircraft flew over the site, dropping about 100 leaflets that local police described as “pornographic” and “libelous.” Word had it that a spurned lover had decided to get even by

depositing sexually explicit photos at a Y-12 employee's workplace. Witnesses reported the plane dove to 150 feet above the weapons plant, in violation of federal aviation rules.

At the time, I was an advisor to Energy Secretary Hazel R. O'Leary, and it disturbed me that this stunt was treated merely as a racy instance of littering. I had just toured the site's main storage facility for highly enriched uranium (HEU)—a 51 year-old wooden warehouse manifestly unsuited to store highly flammable fissile material. A fire at the warehouse, which contained one of the largest stores of weapons grade uranium in the world, could have meant a national radioactive disaster; the ability of a small airplane to fly over Y-12 graphically illustrated how vulnerable the site was to aeronautical accident, or attack.

The United States halted production of new nuclear weapons in 1989, with the end of the Cold War. But the US nuclear weapons complex—composed of eight key facilities that have an annual budget exceeding $8 billion—has stumbled on, in the form of a massive, decaying empire that in many cases does its work poorly or dangerously, or both. The Y-12 National Security Complex is the poster child for much of what ails the weapons complex. Although Y-12 has not produced weapons for some 25 years, its annual budgets have increased by nearly 50 percent since 1997, to more than $1 billion a year.

For decades, the Energy Department—which manages the weapons complex through the National Nuclear Security Agency (NNSA)—has not been able to reconcile competing objectives at the 811-acre Y-12 site, whether they involve storage areas for HEU and other fissile materials, the restarting of old weapons facilities, environmental cleanup, the building of new weapons facilities, or the downsizing of the site. As a result, costs have significantly increased, and long-standing problems have continued, unresolved, for years that have run into decades. For every dollar spent to maintain and modernize the US nuclear weapons stockpile, nearly three dollars is spent "to provide the underlying infrastructure" for maintenance and modernization at Y-12.

Long-term secrecy and isolation have created a dangerous form of hoarding at Y-12; a panoply of severe hazards continues to build up, constantly awaiting ever more costly mitigation in the future. But the stark reality is that there are no more cans to kick down the road. Y-12 has inexorably caught up with its future. Its environmental and security problems are too threatening to leave unaddressed, and questions about its mission will have to be answered definitively in an age of budgetary austerity and relatively little need for new nuclear weapons.

A historic mission, now history. Construction of the Y-12 complex began in 1942 in Bear Creek Valley, nested between the Great Smoky Mountains and the Cumberland Mountains, about 18 miles from Knoxville, Tennessee. Its primary mission at the time was to produce sufficient quantities of uranium 235 for the Hiroshima atomic weapon. During this period, some 50,000 people were employed to operate electromagnetic separation facilities (calutrons) designed by nuclear physicist Ernest O. Lawrence and his research team at the University of California. "By any scale, the operation there was mammoth," historian Gregg Herken wrote in his 2002 book, *Brotherhood of the Bomb*. Two 500-tank calutron "race tracks" were installed "each measuring four football fields long." By 1946, the uranium-enrichment operation was shifted to the Oak Ridge K-25 Gaseous Diffusion Plant, sharply curtailing the calutron operations.

In 1949, the Y-12 plant began a significant transformation, becoming a major center for the processing of nuclear and other materials and the fabrication of nuclear weapons components during the Cold War. Over time, the plant acquired foundry operations for shaping highly enriched uranium and depleted uranium, production facilities for lithium used in nuclear weapons, weapon-component fabrication and dismantlement operations, and storage facilities for a variety of materials used in the manufacture of nuclear weapons. In addition to building several types of fission warheads, Y-12 produced the components for the canned sub-assemblies (CSAs) used in US hydrogen bombs. CSAs contained the highly enriched uranium, lithium deuteride, depleted uranium and other materials that are squeezed to about one-thirtieth of their size and heated to the temperature of the sun's surface by the fission detonation that triggers hydrogen bombs. More than 70,000 weapons components have been made at Y-12 since the late 1940s.

During its heyday, Y-12 produced some 1,000 CSAs per year. Now, its annual production capacity has dwindled to less than 100. Though the NNSA declares that Y-12 has multiple missions, including non-proliferation efforts that involve the downblending of HEU and the provision of fuel for the Navy's nuclear-powered submarines, nearly 99 percent of its budget comes from funds dedicated to maintain the US nuclear weapons stockpile. More than anything, Y-12 serves to stockpile thousands of CSAs from discarded nuclear weapons, as well as depleted uranium, lithium, and other hazardous chemicals.

Because Y-12's historical role—producing the components for vast numbers of thermonuclear warheads—has largely vanished, the NNSA has made a number of attempts to stretch the national security mission of the complex, and some of those attempts also

stretch the boundaries of imagination. Meanwhile, the Government Accountability Office finds that "NNSA's decision to retain many CSAs … poses significant challenges to Y-12's ability to plan its disassembly workload." Although exact numbers have been classified since the 1990s, there are likely several thousand excess CSAs, containing hundreds of tons of HEU, awaiting dismantlement at Y-12.

Problems, unaddressed for years and years. In the aftermath of my 1995 visit to Y-12, nuclear weapons officials in the Energy Department did their best to stall a planned vulnerability assessment of the department's highly enriched uranium storage operations, mainly because of the large potential cost of fixing problems at Y-12. Hundreds of tons of HEU were stored at Y-12 then. Just a year earlier, Building 9212, Y-12's main uranium processing facility, had been shut down as a result of serious safety violations uncovered by the Defense Nuclear Facility Safety Board (DNFSB). This setback renewed serious discussion in Energy Department headquarters of closing Y-12 altogether. The discussion proved to be idle chatter. The impacts of closing Y-12, which has dominated the wage and benefit structure for several generations in east Tennessee, was not lost on the White House, mindful of the 1996 elections.

Around New Year's Eve of 1996, a long-awaited vulnerability assessment of HEU storage at Energy Department sites was released. Y-12 had the most significant problems. Even though fires posed the greatest danger of radiation and chemical exposure to workers and the public, buildings, mostly constructed in the 1940's, had deteriorated and had insufficient or non-existent fire-protection systems, despite the very real possibility of a truly catastrophic fire and resulting release of radiation. It wasn't until 14 years later that a replacement facility for the aged wooden structure serving as the main HEU storage warehouse was opened; it cost five times the original construction estimate. That facility gained notoriety in August 2012, after nonviolent peace protestors, including an 84-year-old nun, penetrated its security barriers.

Making matters worse, there was a backlog of more than 100 tons of "combustible in process materials" that had accumulated in "virtually every building." Containers holding unstable and flamable forms of HEU sat for decades in hallways, narrow production aisles, and in process lines. Inspectors found that the site's overall safety plan "often does not contain such fundamental information as the physical forms, storage configurations, or inventories of HEU assumed to be present in the facilities; and, therefore, were not evaluated for potential releases during major accident scenarios." And more than 60 percent

of the many thousands of containers holding HEU had never been opened and lacked documentation as to what was inside.

To its credit, the Defense Nuclear Facility Safety Board has played an important role over the past 20 years in improving safety at Y-12 and continues to pressure the NNSA to come to terms with problems there. Several improvements have been made, particularly regarding the removal of unstable nuclear material from deteriorated structures, safer packaging of nuclear materials, upgrading fire protection, and establishing a formalized safety culture.

But these improvements haven't come close to eliminating Y-12's many security, environmental, and budgetary problems. Between 2006 and 2011, remote-controlled equipment meant to protect workers from inhaling uranium failed in Building 9212. For five years, kneeling workers had to load uranium oxide by hand into canisters, while wearing respirators.

From 1997 to 2006, there were 21 fires and explosions at Y-12 involving electrical equipment, glove boxes, pumps, waste containers, and nuclear and hazardous chemicals. Several resulted in worker injuries and destruction of property.

After the 1994 shutdown of Building 9212, it took 12 years for uranium processing operations to restart there. The cost of resuming operations was more than $500 million—five times the original estimate. The facility has yet to achieve an adequate capacity to process the backlog of unstable materials and produce purified HEU.

An inability to downsize. Although the end of the Cold War has eliminated much of Y-12's bomb-manufacturing mission, attempts to downsize by eliminating ancient, excess infrastructure have largely been unsuccessful. More than half of the Y-12's structures were built in the 1940s. Several buildings have been shuttered for years and are seriously deteriorated. Years of leaking roofs have created chronic safety problems, including standing water in fissile material storage areas and water accumulation near electric control panels. In March 2014, a large portion of a concrete ceiling collapsed in a building that was once part of the weapons operation. It was a near miss: Foot-long concrete pieces bounced onto walkways and an area where welders had been working just a day before.

Over the course of nearly 20 years, however, several plans to downsize the Y-12 complex have foundered. In 1989, the National Research Council noted that Y-12 buildings occupied

approximately 5.5 million square feet. Eight years later, the Energy Department announced that "by about the year 2003, the Y-12 facility would be approximately 10 to 20 percent the size of the existing plan." As of this year, the square footage had shrunk by only about 7 percent. Even with this modest space reduction, the total Y-12 footprint is comparable to the square footage of the Nissan car assembly plants in Tennessee, which produces more than 550,000 vehicles annually.

Other attempts to close facilities at Y-12 have also evaporated. These failures are mainly due to the large expense of downsizing, which would increase the NNSA's budget and compete with funds for weapons modernization. Congress is less likely to approve large-scale spending for downsizing antiquated structures than for a mission of maintaining thousands of nuclear weapons for national defense. And so efforts to close or dramatically shrink Y-12 have gone nowhere.

In 2005 a Department of Energy Task Force on the Nuclear Weapons Complex Infrastructure, citing the lack of "modern-day production technology," recommended the closure of the Y-12 complex and urged the Energy Department to "immediately begin site selection processes for building a modern set of production facilities with 21st century cutting-edge nuclear component production, manufacturing, and assembly technologies, all at one location." After the Tennessee and other congressional delegations created a political uproar, the Energy Department decided to proceed with a policy of "modernization in-place."

Modernizing by cost overrun. In 2007, the NNSA began to seek funds from Congress for the Uranium Processing Facility (UPF), which would replace several dilapidated plants at the aging Y-12 site. The UPF was to use new technologies, under development at Y-12 for more than a decade, to replace the chemical conversion and foundry processes used to create HEU weapons components since the 1950s.

The projected total project cost was $1 billion and operations were expected to begin as early as fiscal year 2013. As with nearly other new high-hazard nuclear facilities promised by the Energy Department, however, costs for the UPF have soared and its schedule has slipped by several years. The price tag for the UPF, renamed the Uranium Capabilities Replacement Project, now ranges from $6.5 billion to $19 billion.

With a projected workload an order of magnitude less than during the period of peak weapons production, a major question remains: What should the capacity of the UPF be? The large stockpile of thermonuclear components sitting at Y-12, justified in large part for potential reuse in a dwindling nuclear arsenal, implies that a very modest production capacity is needed.

In April 2014, the NNSA released a "red team" report, led by the director of Oak Ridge National Laboratory, on the troubled UPF. The team's most significant recommendation was to rethink a basic, "big-box" approach that would create a UPF to serve multiple functions in one structure. Instead, to hold the line at an estimated $6.5 billion for design and construction costs, the team recommended going back to the drawing board to effectively reduce the size and scope of the project. Meanwhile, in recognition of the growing hazards associated with a deteriorating infrastructure for storing "materials at risk," the team recommended that greater emphasis should be given to safe consolidated storage of materials, deferred maintenance, and safety upgrading.

Conspicuous by their absence were explicit references to downsizing Y-12 overall.

The mercury threat. Activities at Y-12 have produced multiple environmental challenges; perhaps the largest is mercury pollution.

During the crash program to build thermonuclear weapons in the 1950's and early 1960's, Y-12 purchased about 24 million pounds of mercury to purify lithium. Of that amount, about 10 percent (2.4 million pounds) was released into the environment or could not be accounted for inside buildings. To put the problem in perspective, Y-12 mercury losses are about eight times the annual mercury emissions estimated by the Environmental Protection Agency for the entire United States during the years 1994 and 1995.

Despite the well-recognized hazards of mercury, a neurological poison, workers were not provided with adequate protection from it. People living nearby, including hundreds of school children, were exposed for years to an estimated 73,000 pounds of mercury released to the air. In 2012, the Agency for Toxic Substances and Disease Registry concluded that "elemental mercury carried from the Y-12 plant by workers into their homes could potentially have harmed their families (especially young children)." A rough measure of harm to workers can be found in compensation statistics maintained by the Department of

Labor. Nearly 9,000 Y-12 workers have received some $417 million for exposure to non-radioactive substances.

The Upper East Fork Poplar Creek and Bear Creek continuously transport about 500 pounds of mercury from heavily contaminated soil on the site to downstream areas. The contaminated creeks then feed into the lower Watts Bar reservoir of the Tennessee River and the Clinch River, where tens of tons of mercury have accumulated in sediments. In 2002, nearly 40 percent of the anglers using the Watts Bar Reservoir continued to eat mercury-contaminated fish, despite a public ban on consumption. African-Americans were the least aware of the ban and were the most vulnerable to potential harm.

After recognizing the magnitude of the mercury problem at least 35 years ago, the Energy Department is just beginning to construct a water treatment plant to remove mercury from the contaminated creeks and to reduce offsite mercury run-off. The total cost of mercury cleanup at Y-12 has not been determined. However, it may rival the cleanup costs of profoundly contaminated areas such as the Hanford Site in southeastern Washington state.

Cosmic mission creep. The current national security mission at Y-12 is so ill-defined and expansive that it strains credulity. For instance, the Government Accountability Office recently reported that one of the primary justifications for stockpiling excess canned sub-assemblies at Y-12 is "for potential use in planetary defense against earthbound asteroids." In 2013, the Obama administration convened a senior-level team and established a now-stalled joint project with Russia to try to fend off asteroids bound for Earth, using nuclear weapons.

Regardless of the wisdom of or need for an asteroid-protection program, the future of Y-12 should be focused on earthly realities: cleaning up the environment, decontamination and decommissioning of facilities, stabilizing nuclear and other hazardous materials, and the dismantlement of a large excess stockpile of weapons components. There is a very real need to replace the collapsing infrastructure at Y-12 with facilities that can accomplish these goals.

Protecting the planet from asteroids is a poor rationale for failing to deal with the environmental, safety, financial, and health challenges the Y-12 site poses to the people who live in the area, and to the country as a whole.

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A senior scholar at the Institute for Policy Studies, Robert Alvarez served as senior policy adviser to the Energy Department's secretary and deputy assistant secretary for national security and the environment from 1993 to 1999. During this tenure, he led teams in North Korea to establish control of nuclear weapons materials. He also coordinated the Energy Department's nuclear material strategic planning and established the department's first asset management program. Before joining the Energy Department, Alvarez served for five years as a senior investigator for the US Senate Committee on Governmental Affairs, chaired by Sen. John Glenn, and as one of the Senate's primary staff experts on the US nuclear weapons program. In 1975, Alvarez helped found and direct the Environmental Policy Institute, a respected national public interest organization. He also helped organize a successful lawsuit on behalf of the family of Karen Silkwood, a nuclear worker and active union member who was killed under mysterious circumstances in 1974. Alvarez has published articles in *Science*, the *Bulletin of Atomic Scientists*, *Technology Review*, and *The Washington Post*. He has been featured in television programs such as *NOVA* and *60 Minutes*.