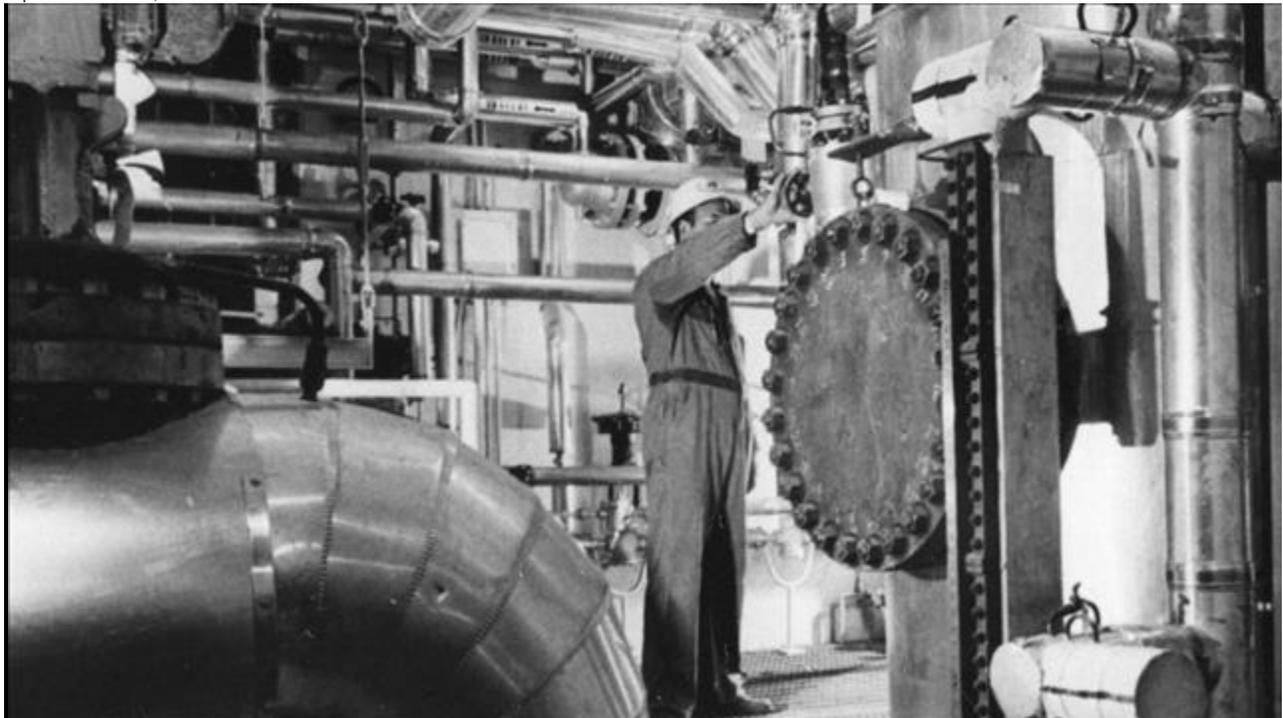


A Nuclear Cleanup Effort Leaves Questions Lingering at Scores of Old Sites

Years Later, the Legacy of the U.S. Arms Buildup Remains Near Homes, Parks and Malls

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WSJ's John Emshwiller and Jeremy Singer-Vine detail their yearlong investigation into the fate of hundreds of Cold War-era nuclear manufacturing and research sites.

It was a discovery that helped launch the nuclear age. On the eve of America's entry into World War II, scientists isolated plutonium in a small room in UC Berkeley's Gilman Hall. To make sure the moment wasn't forgotten, Room 307 was designated a National Historic Landmark.

As it turned out, there would be plenty of other reminders. The work left radioactive residue that forced the university to rip out an entire adjacent room in 1957, according to its own documents. A quarter-century later, while professors and students were still using the building, the school found that a dozen other rooms and some hallways were contaminated.

The school cleaned those up too—only to discover this year small amounts of residue in a study room.

Carolyn Mac Kenzie, the university's radiation safety officer, says any current exposure is "well under" federal safety limits. Still, she says that before the 1980s cleanup, administrators or students there could have breathed in harmful levels. "We will never know," she says.

The contamination at Berkeley is part of the legacy of one of the most important scientific and industrial undertakings in U.S. history. During the buildup to the Cold War, the federal government turned to the private sector to help develop and produce nuclear weapons and other forms of atomic energy. Hundreds of companies and thousands of workers were pressed into service. But while it helped defend a country, this enormous endeavor has left an equally enormous—but rarely publicized—cleanup job of contamination that spans the country.

Residue, left by the routine processing as well as the occasional mishandling of nuclear material, exists in sites in almost three dozen states. Some remains in public parks, some near schools, and some in the walls, floors and ceilings of commercial buildings. Contamination has been detected on hiking trails in residential neighborhoods, in vacant city lots and in groundwater.



The government is considering a cleanup at a Staten Island site where uranium was once stored. *Ross Mantle for The Wall Street Journal*

Federal officials say they have taken adequate measures to protect the public health and that the sites don't pose a threat to anyone living or working nearby. While some research has raised concerns, there is no conclusive evidence linking the sites to any public-health problems. In general, studies haven't pinpointed the exact relationship between exposure to low-level radiation and medical issues such as cancer.

But a Wall Street Journal investigation raises other questions about the massive government program established to handle one of the country's longest running and most expensive cleanups. Among the findings:

- Record-keeping has been so spotty that the Energy Department says it doesn't have enough documentation on several dozen sites to decide whether a cleanup is needed or not.
- Despite years of trying to track these sites, the government doesn't have the exact address for dozens of them. It acknowledges it doesn't even know what state one uranium-handling facility was located in.
- More than 20 sites initially declared safe by the government have required additional cleanups, sometimes more than once.

"What we have learned from the nuclear program is that it is a surprise when there are no surprises," says Robert Alvarez, a former senior Energy Department official during the Clinton administration.

In its investigation, the Journal sifted through tens of thousands of pages of government documents and company records; consulted property records, photographs and historical maps; and conducted interviews with hundreds of individuals, including former tenants and owners. Information from the Energy Department as well as a dozen other federal and state agencies was gathered in the search. [The results of that research—covering over 500 sites—are in an online database.](#)

Government records show that a large majority of those sites, which included factories, research centers and other facilities, handled radioactive material. Over the decades, an array of federal agencies have reviewed records to determine which sites were potentially dangerous. So far, the government has deemed about 130 sites worrisome enough to warrant a cleanup, and says it has finished work on 90 of them. Total projected cost: \$350 billion.

The Energy Department declined requests for interviews but issued a statement to the Journal saying it was "confident" it had identified all of the sites and nearly all of the contaminated areas at those locations. "We continue to evaluate these sites through environmental sampling and records searches to determine whether additional contaminated areas exist," the statement said.



An old storage facility for the Manhattan Project on W. 20th Street, New York, was cleaned up. *Ross Mantle for The Wall Street Journal*

The smaller sites stand in contrast to a handful of giant nuclear facilities that have grabbed national headlines—such as the 586-square-mile complex in Hanford, Wash., which officials estimate will account for \$150 billion of the total cleanup tab. But while they are far less contaminated than the Hanfords of the world, the smaller sites are closer to population centers and are harder to track through a series of private operators.

Indeed, according to the Journal's database, more than four million Americans live within a mile of one of the roughly 300 sites the Journal could pinpoint. About one million live within a half mile. Some 260 public schools are also within a half mile of a site, as are 600 public parks. Still, most current owners or occupants contacted by the Journal didn't know about the locations' past.

"Now you've got me scared," said Sal Mazzio with a nervous laugh, upon learning that his Staten Island towing company sits on a former World War II storage site for uranium ore. Federal officials are looking at doing a cleanup there, though they say there is no imminent health risk.

"I should be thrilled that I'm in such excellent health," said JoAnn LaFon upon hearing that her Alexandria, Va., townhouse is on the site of a former factory that worked with uranium and thorium. Ms. LaFon said that to build her complex's 29 townhomes nearly 20 years ago, the developer tore down the factory and cleaned up the site. Still, she wondered if there was any remaining residue. Available records don't show the government felt the site needed a cleanup.

At a group of buildings in the 500 block of W. 20th Street in Manhattan, federal records shows that in the 1940s the Manhattan Project—the research-and-development effort that led to the first atomic bomb—stored some 300,000 pounds of uranium products in what served as warehouses at the time.



A gamma detector. *Ross Mantle for The Wall Street Journal*

In that case, the federal inspectors in 1989 found radioactive contamination up to 38 times federally allowed levels in parts of the structures, according to a 1995 Energy Department report. After hauling off 50 drums of contaminated material recovered from vacuuming, scraping and other work, the government declared the buildings fit for "unrestricted use." The buildings are currently occupied by dozens of offices and art galleries. A woman who described herself as one of the owners but didn't give her name said she didn't know about any past contamination and declined to comment.

Determining actual risks from radiation is far from a precise science; much of it is based on long-term health studies of World War II atomic-bomb survivors in Japan. Current scientific thinking holds that even the smallest amount of additional radiation raises a person's cancer risk slightly, with the danger rising with the dose.

Generally, the relatively low levels of radiation at most old nuclear sites aren't viewed as a short-term danger. Any exposure would occur in the soil, air and groundwater. Richard Muller, professor of physics at the University of California, Berkeley, said government exposure limits are "often set so far into the safety zone nobody should worry" about them.



Scientist Glenn Seaborg discovered plutonium in a UC Berkeley building where residue has lasted for decades. *University of California, Lawrence Berkeley National Laboratory*

Cleanup responsibilities have been divided among an array of federal agencies—including the Energy Department, the Nuclear Regulatory Commission, the Army Corps of Engineers and the Environmental Protection Agency. The National Institute for Occupational Safety and Health also weighs in on scores of sites under a program to compensate nuclear-weapons plant workers for radiation-linked cancers.

Still, sometimes it has taken citizens to find contamination problems. In 1978, a college geology student in Attleboro, Mass., carrying his own detection equipment discovered radioactive junk at a local landfill. That sparked a federal cleanup that was completed in 2012, three decades after the student's find. A 2011 state health study found elevated levels of a few types of cancers within a mile of the site, but said "the elevations were not statistically significant."

In the 1970s, federal officials decided that a factory in Fort Wayne, Ind., which had machined uranium for the weapons program, didn't need a cleanup. However, in 2004 a buyer of the facility found radiation there during an environmental review. That site is now slated for a government cleanup, though it isn't expected to begin for several years, officials say.

Even after being cleaned, many sites still contain residual radioactive contamination. "Cleanup does not imply that all hazards will be removed from a given site," the Energy Department said in its statement to the Journal. Often, the taint is so slight that it poses no public-health risk, government officials say. But in about 50 completed cleanups, enough contamination remains that the federal government has imposed "institutional controls," restricting how the area or facility can be used. Such restrictions could last "for centuries or, in some cases, millennia," one Energy Department report said.

Degrees of Danger

There is an ongoing debate over the health risks posed by long-term, steady absorption by the body of radiation energy at doses measured in millirem. One major exposure theory says the risk is cumulative: The more radiation absorbed over time, the greater the danger.

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1 millirem (mrem)

1,000th of a rem. The BEIR VII report estimated that 1,000 millirem of radiation could produce roughly one additional cancer per 1,000 people receiving that dose.

•

4 mrem

A typical chest x-ray*

•

5 mrem

Amount per hour measured at contact on a surface area at Gilman Hall at U.C. Berkeley in the early 1980s*

•

15 mrem

The EPA's current allowable annual exposure limit for a site cleanup

•

30 mrem

A mammogram*

•

100 mrem

Allowable annual exposure at some past nuclear cleanup projects

20,000 mrem

The former Mound nuclear complex in Miamisburg, Ohio, can't be used for day-care centers, elementary schools or other activities where children would spend too much time. While the government says the contamination levels don't threaten adults in offices or doing other work at what is now a technology-business park, research has shown children to be more at risk from radiation exposure.

Eric Cluxton, president of the nonprofit Mound Development Corp., says he checked with the Energy Department to make sure it was all right to let kids come to this year's annual Thanksgiving "Turkey Trot" 5-mile run being hosted by Mound. The government gave the green light.

The U.S. entered the atomic age in the 1940s, with the Franklin Roosevelt administration moving ahead with developing a nuclear bomb just before the attack on Pearl Harbor. Adding urgency, U.S. officials feared Nazi Germany was already well into its own bomb project.

The Staten Island site now being considered for cleanup was the repository for 1,200 tons of extremely high-grade uranium ore from the Belgian Congo that a European business executive had shipped to the U.S. in 1940 to keep it from the Nazis. Forty years later, federal records show, the Energy Department found residual contamination at the site. Even though the uranium had eventually been purchased for the Manhattan Project, the department decided the site didn't qualify for a federal cleanup because the ore had been owned by private companies while it sat on Staten Island.

The department said it decided to reconsider the site's eligibility at the request of other government agencies. A 2012 federal report calculated that potential radiation exposure in a relatively remote and unused corner of the property, part of which now hosts Mr. Mazzio's towing company, could be up to about 10 times current standards.

Such were the challenges of building the first bomb that Niels Bohr, the Nobel Prize-winning Danish physicist, reportedly once remarked that an entire country would have to turn itself into a factory to build the weapon. After viewing the labors and results of the Manhattan Project, Mr. Bohr concluded America had done just that.

Remnants of that remarkable effort are buried in two clearings in the thickly wooded park lands of southwestern Cook County, Ill. During World War II, the world's first nuclear reactor—which had gone into operation at the University of Chicago—was moved there. Over the ensuing decade, a 19-acre, 35-building complex, including a second reactor, rose around it.

Officials dismantled the place in the 1950s. They dumped parts of the two reactors, helped by some well-placed explosives, into a ditch 100 feet wide by 40 feet deep. The hole was then "filled, leveled and landscaped," said an Energy Department document. This "Site A" is less than a third of a mile from "Plot M," a nearly a half-acre burial plot holding contaminated building debris, equipment and clothing.

Over the years, radioactive tritium turned up in groundwater, including some at a nearby picnic site; officials monitoring the tritium say it doesn't pose a health threat. In 1990, state workers discovered above ground uranium metal, concrete rubble, protruding pipes and elevated radiation levels at Site A. That prompted a federal cleanup. Erosion from bicyclists riding over Plot M is a continuing issue, according to a 2012 Energy Department report.

On weekends, several dozen people might pass by the sites, said James Phillips, a biologist for the Forest Preserve District of Cook County on a walk to them past stands of oak and maple trees amid the din of cicadas. "It's amazing to think that Einstein, Oppenheimer and Fermi" might have walked in the same woods, he said, referring to three pioneers of the nuclear age. Mr.

Phillips said some winter visitors claim that because of heat from radioactive contamination snow doesn't gather at Plot M, but he dismissed that as urban legend.

A stone monument at Site A proclaims the resting place of "The World's First Nuclear Reactor." The stone cube at Plot M carries a more ominous message: "Caution—Do Not Dig. Buried in this area is radioactive material from nuclear research." The message adds: "There is no danger to visitors," though some passing editor chiseled off the word "no." Cook County officials say they are working on a campaign to attract more visitors by better publicizing the sites and their role in history.

The Manhattan Project's urgency and secrecy—carried over during the Cold War struggle with the Soviet Union—"made it possible to give short shrift to complaints other industries would have to face, such as pollution and health issues," says John Applegate, an environmental-law professor at Indiana University who served on an Energy Department cleanup advisory board during the Clinton administration.

In the 1980s, a public outcry began rising over such health and safety issues. One turning point, say current and former government officials, came in the small Ohio town of Fernald, where a big federal complex processed weapons-related uranium. Worker complaints of unsafe plant conditions, coupled with radioactive contamination found in nearby drinking wells, drew national attention.

Joseph Fitzgerald, a former senior Energy Department official, toured Fernald in 1985. "The entire plant was contaminated. There were piles of uranium on the floor," he recalls. Ultimately, Fernald underwent a \$4.4 billion cleanup, prompted in part by the ardent interest of then-Sen. John Glenn, who became an outspoken advocate for cleaning up weapons contamination nationally. In a recent interview, the former senator said, he concluded Fernald had been "just the tip of the iceberg."

Today, even nuclear critics say Fernald is among the most successful cleanups to date. Part of the 1,050-acre site is a nature preserve and visitors center. Still, there is also a 65-foot-high mound containing mildly radioactive debris and a plant to remove contamination from groundwater. A flier warns hikers not to handle anything resembling construction debris—in case it is a fragment from the old nuclear complex.

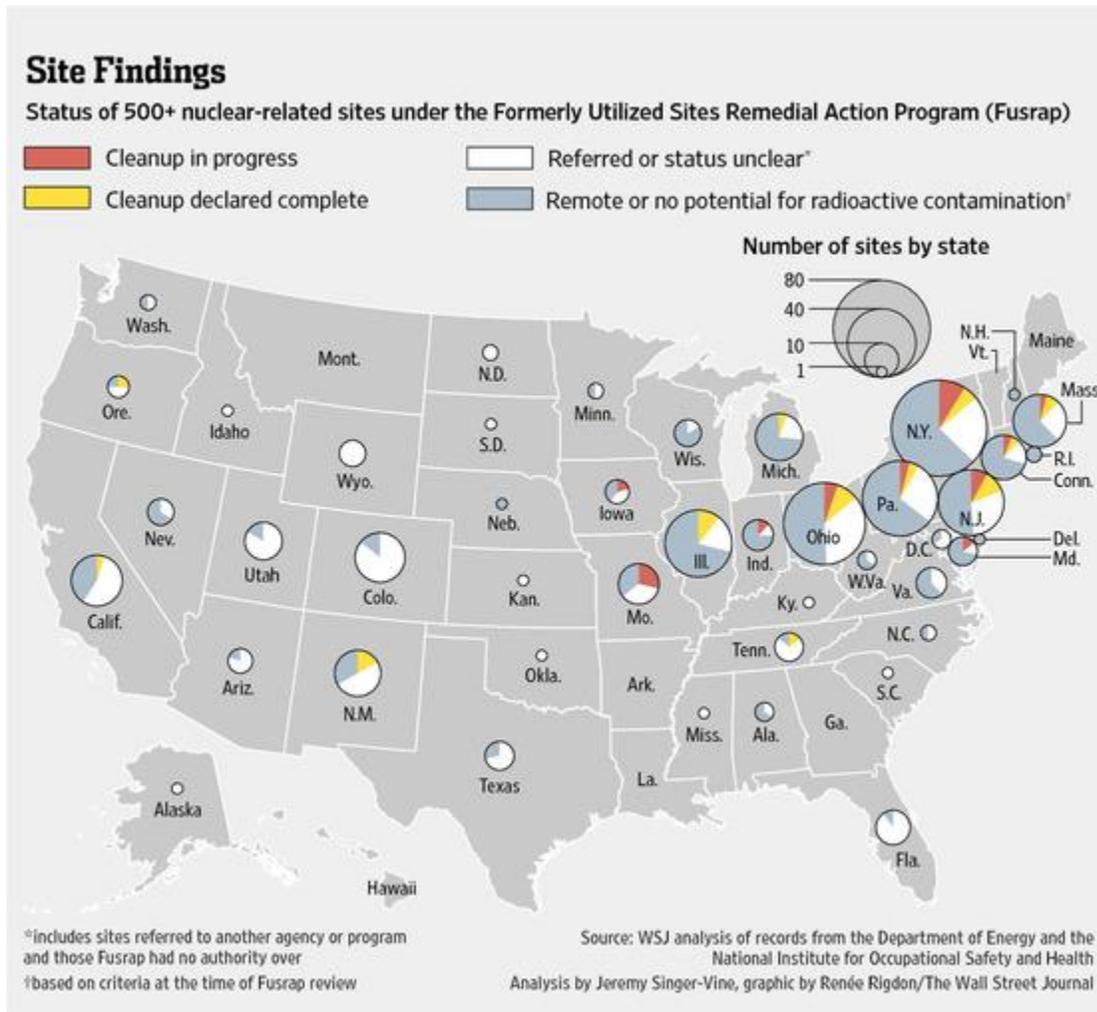
In 1989, the Energy Department agreed to pay more than \$70 million to settle a lawsuit by residents near the plant who said the facility had caused emotional distress and diminished property values. The agency didn't admit to any proof of harmful effects, but the settlement did fund long-term medical monitoring by researchers at the University of Cincinnati and a local medical center. Last year, they reported "a higher than average rate" of lupus among people who lived near the former plant and said more investigation was needed.

The end of the Cold War contributed to some reordering of nuclear priorities. In the 1990s, annual spending on nuclear-weapons cleanup for the first time surpassed the nuclear-weapons budget. The department began declassifying documents and making more site-related information available.

A small part of the billions going annually to the overall cleanup went to a program to address the hundreds of privately owned locations that had taken part in the nuclear-weapons drive. It went by the bureaucratic name of Formerly Utilized Sites Remedial Action Program, or FUSRAP.

Begun in 1974, FUSRAP was considered something of a backwater, say many former officials. Through 1997, FUSRAP's annual budget never topped \$75 million, though it was responsible for

cleaning up several dozen sites. Fusrap "never had enough money to do the job," says Graham Mitchell, a former Ohio state environmental regulator involved in nuclear cleanups.



In 1997, Congress took the program away from the Energy Department and gave it to the Army Corps of Engineers. Congress raised the annual Fusrap budget to about \$140 million, where it pretty much stayed until each of the last two years, when it was cut to about \$100 million. Fusrap has some two dozen pending projects, including at least one that could cost up to \$500 million.

Fusrap has had challenges besides funding. When one former Energy Department official learned the Journal was seeking addresses for the hundreds of company locations, he let out a brief laugh. "Huh, good luck." He recounted how department officials during the 1980s and 1990s had engaged in a similar search. Many of the addresses in government records were for a company's headquarters rather than the actual nuclear work sites. (Part of the Journal database cites Fusrap findings.) Some locations had addresses on streets that no longer existed. "We were not able to assess all the sites," he said.

One that went missing was Transcontinental Machine & Tool, which did uranium metal machining, according to a 1951 government document. The Energy Department says it hasn't found a record of the city or even the state where Transcontinental operated. "Although there is some potential for contamination, the location of the site is unknown and therefore the site cannot be surveyed," said a 1990 DOE report. Based on experiences at other uranium-machining shops,

the contamination worry was low, the report added. (A 1941 article in an online newspaper archive mentions a Transcontinental Machine & Tool in New York City.)

Some sites have undergone multiple cleanups. For years, the Acid Canyon area in New Mexico served as a dumping spot for the nearby Los Alamos National Laboratory. In the 1960s, federal records show, the government removed plutonium and other contaminants from the canyon and transferred the land to Los Alamos County, which turned it into a public hiking and recreation area.

In the 1970s, the government found more contamination and did another cleanup. In the late 1990s, state officials found yet more contamination. According to news reports at the time, the Energy Department brought in a truck-mounted vacuum and removed several hundred cubic yards of soil. The work was needed, the Energy Department said, because rainstorms sometimes uncover more radiation, but that removing all the contamination would mean stripping vegetation and soil, impacting the ecosystem there. The area is safe for recreation, the department added.

Middlesex, N.J., a hamlet of about 14,000 people, 30 miles from New York City, is also facing its third round of cleanup. In the late 1940s, the Atomic Energy Commission dispersed contaminated material from a nearby nuclear-weapons facility over 5 acres of a municipal landfill there, according to federal records.

In 1960, citizens practicing civil-defense drills with Geiger counters discovered radiation readings up to 50 times natural background levels. After a cleanup, the government cleared the property for public use. Part of it became home to the Middlesex Presbyterian Church. In the mid-1970s, federal officials found more contamination about 400 feet from the church and did another cleanup. Neal Presa, current pastor at the church, said federal officials have assured him there isn't any danger to his flock.

In 2001, the borough of Middlesex, looking to develop part of the site into a recreation area, discovered yet more contamination, this time at an end of the property away from the church but near a residential street. Twelve years later, the Army Corps of Engineers is looking at doing another cleanup at this new spot. It says there isn't any imminent risk to the public.

Ronald Dobies, mayor of Middlesex for most of the years since 1980, sat in his small office recently and recounted the town's nuclear history while pointing at boxes and files containing atomic-related papers. City Hall is a stone's throw from the landfill, which is largely overgrown with shrubs and weeds and fenced in—though a gate at the end of the site near the latest contamination discovery stood askew on a recent visit.

In 1983, Mr. Dobies told a federal nuclear advisory panel "it is difficult to express the fears of our citizens in a short presentation." Today, the mayor is less worried about possible health threats. Still, he said, "I am a little surprised that they didn't get all the radiation out" in the past.

The weapons-related work at UC Berkeley's Gilman Hall created contamination headaches from early on, according to documents obtained under a public-records act request. A 1957 university report recounts that contamination in room 309, next to room 307 where plutonium was discovered, was so bad the "ceilings, walls, floor and lab benches were cut into small pieces and sealed in fiberboard drums" by workers wearing "full protective clothing, including respirators." More than 600 cubic feet of material was disposed of as "radioactive waste."

Later surveys found more contamination; "in a total of 12 rooms throughout all floors of the building and in hallways," according to a 1983 report. Another report said the building had 40 areas of contamination.

The university covered the contamination by various means, including with tiles. The result "reduced the dose rate to below detection limits," said the 1983 university report, adding that officials believed occupants hadn't been harmed by prior exposures. A 1991 report added: "It is not feasible to remove all the contamination unless all equipment and furnishings are removed and the building gutted."

"They did a good job of sealing this stuff in," says Ms. Mac Kenzie, the radiation safety officer. If there ever was a serious radiation problem at Gilman, the period of "real hazard" would have been between World War II and about 1980, she says.

Still, issues arise. While putting a new roof on Gilman this year, officials discovered some contamination in a third-floor study room. They temporarily evicted three nuclear-chemistry grad students and closed off part of the room before reopening the rest. Though the potential doses were small, says Ms. Mac Kenzie, "you just don't expose people unnecessarily."

—Neil Parmar and Charity Scott contributed to this article.