The Unfinished West Valley Experience at the Back End of the Nuclear Fuel Cycle, 1960-present

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West Valley Citizen Task Force

Council of State Governments / Blue Ribbon Commission public meeting

Boston, October 12, 2011

The West Valley site is unique

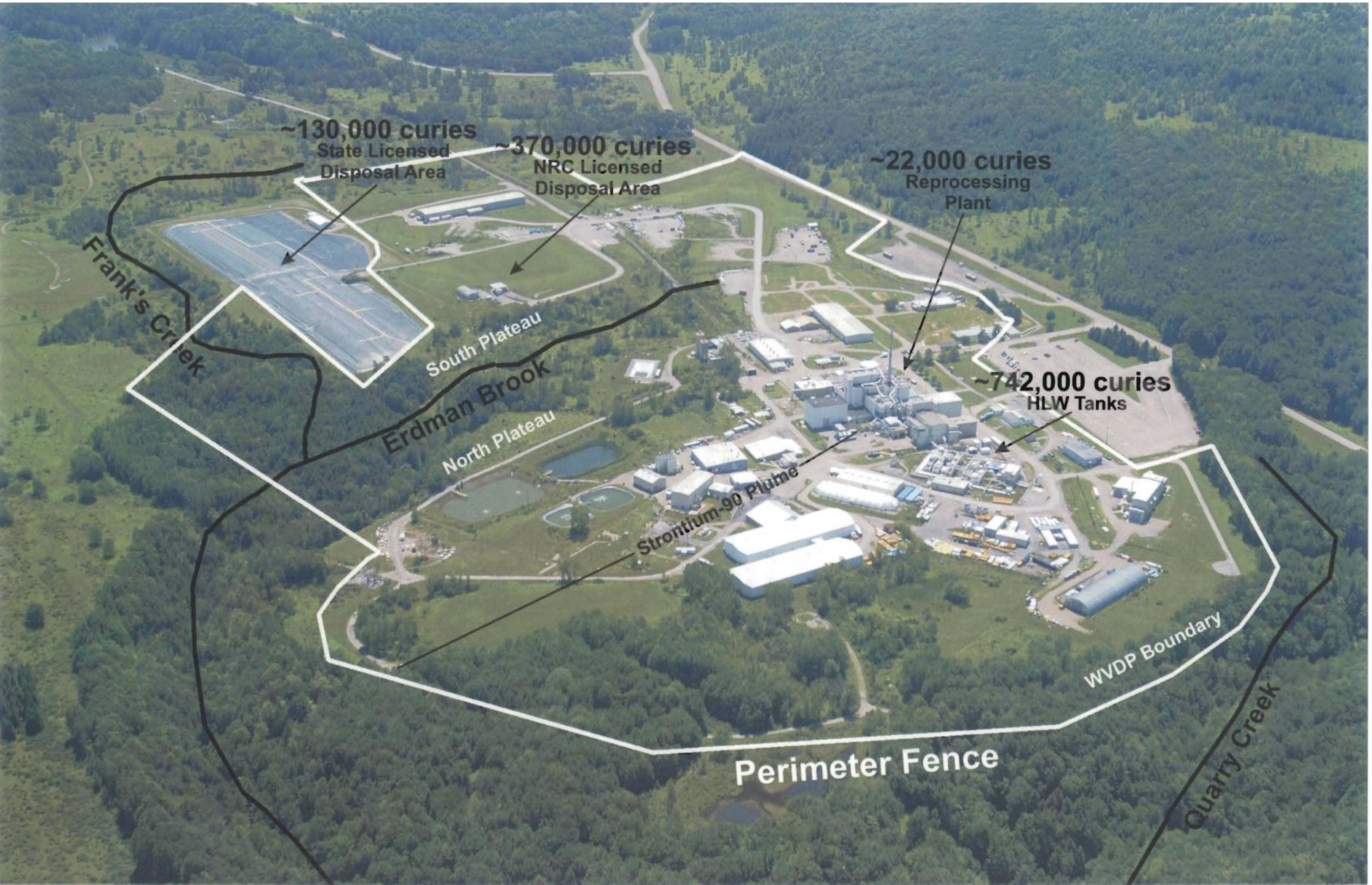
- Only U.S. commercial reprocessing plant (1966-1972)
- Reprocessed both defense and commercial spent fuel
- High worker exposures, poor control of contaminants during period of operation prior to 1980
- Sited on erosion-prone land (glacial fill) in the Great Lakes watershed
- Two onsite burial grounds operated 1963-1975; hold wastes exceeding 10 CFR 61 limits
- Onsite source term includes HLW, TRU, LLW, mixed waste (roughly 16 million curies current total)

The West Valley site is unique

- Site-specific federal law (West Valley Demonstration Project Act of 1980)
- Successful vitrification of HLW from reprocessing
    - ➢ Vitrified HLW is commingled defense and commercial
- Joint state-federal decommissioning is ongoing w/public input including West Valley Citizen Task Force
- Major decommissioning decisions have been deferred until ‘Phase 2’ – will be made in about 9 years
- Many controversies remain (funding, full cleanup?, HLW issues). Full cleanup price tag is about $10 billion.

WEST VALLEY SITE

Vitrified HLW (about 15 million curies) is temporarily stored in reprocessing plant



REPROCESSING

- **From 1966 to 1972, the West Valley facility reprocessed 630 tons of fuel from 9 reactors during 28 campaigns**
- **About 60% of the fuel came from the U.S. Atomic Energy Commission (AEC) as part of its guarantee to supply fuel until an adequate commercial market grew**
- **Fuels processed included light-water reactor fuels (both BWR and PWR), fuels from AEC-owned reactors (esp. the Hanford N-Reactor), and uranium-thorium fuel from the Indian Point 1 reactor**
- **Both metal and oxide fuels were processed; burnup ranged up to 30,000 MWd/MTU**
- **Very dirty operation!** ***High emissions and worker doses*****.**

REPROCESSING: Dirty operation at West Valley!

- **1968 = 2.74 rem/person**
- **1969 = 3.81 rem/person**
- **1970 = 6.76 rem/person**
- **1971 = 7.15 rem/person**

These are *average whole-body exposures* for approx. 250 individual workers. They are *not collective dose*.

When it appeared that the above doses were becoming excessive, up to 1400 temporary workers per year were also brought in for high-dose jobs.

Sources: *ORAU Team Dose Reconstruction Project for NIOSH*, ORAUT-TKBS-0057 (2007), p. 35. A 1978 Battelle-Columbus report lists a slightly higher average (7.23 rem/person) for the 1971 dose. Temporary workers: Robert Gillette, *Science* 186, 125-129 (1974).

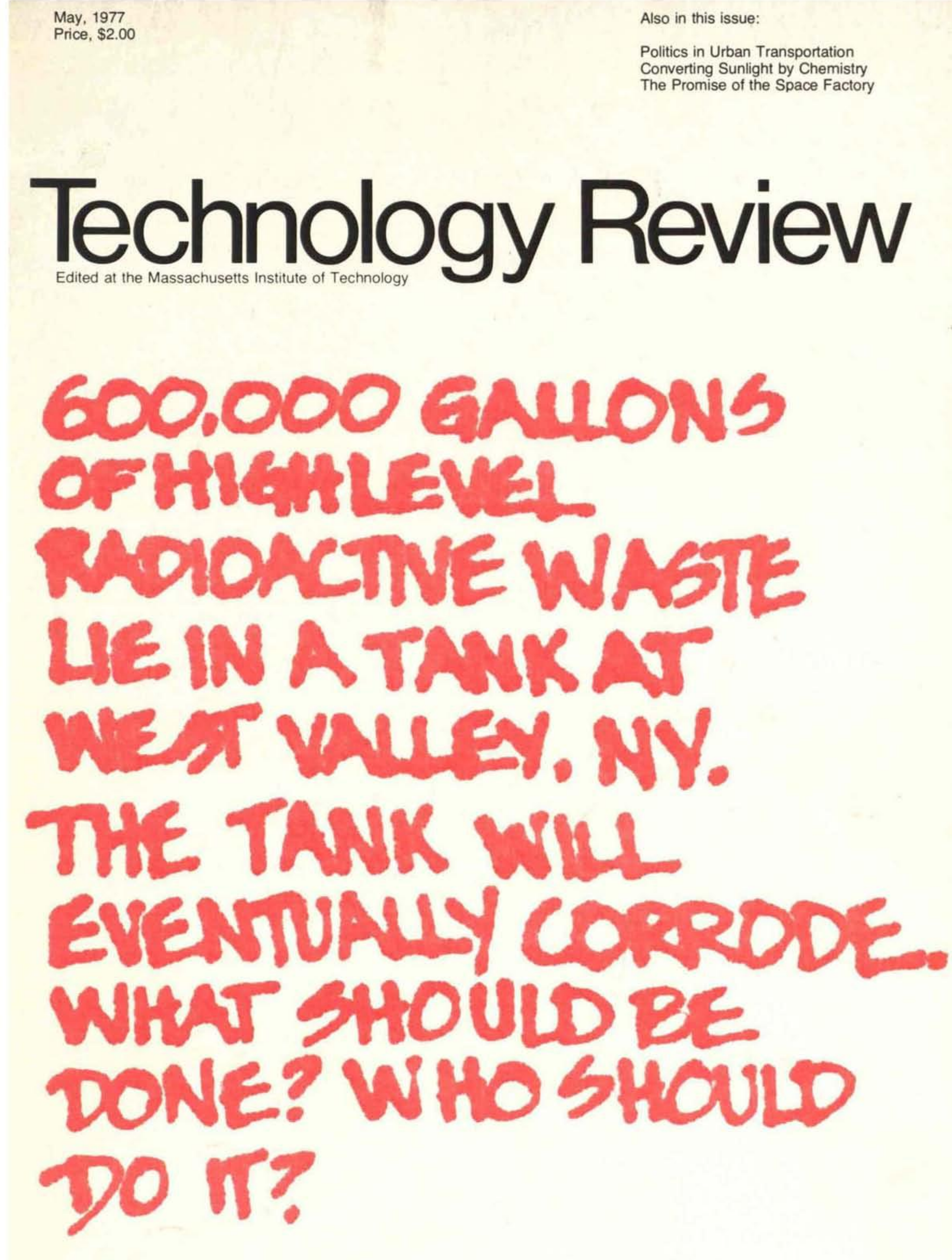
REPROCESSING: Dirty operation at West Valley!

- **High emissions to air and water; contaminant plumes**
- **Various technical problems**
- **Today's meeting is not the place for discussing these issues in detail, but the U.S. reprocessing debate is underway**
- ***We believe our input would be useful in any future Blue Ribbon Commission deliberation on reprocessing, including*:**
  - ➢ **Health, environmental, technical, economic issues**
  - ➢ **Does 'once a waste site' mean 'always a waste site'?**
  - ➢ **Should reprocessing be renamed 'recycling'? (*No!*)**

Reprocessing at the West Valley site ended in 1972, leaving 600,000 gallons of high-level liquid waste.

Waste burial at the site ended in 1975.

The site operator (*Nuclear Fuel Services*) and site owner (*New York*) disagreed with each other and *had not set aside enough money* to deal with the various site issues.

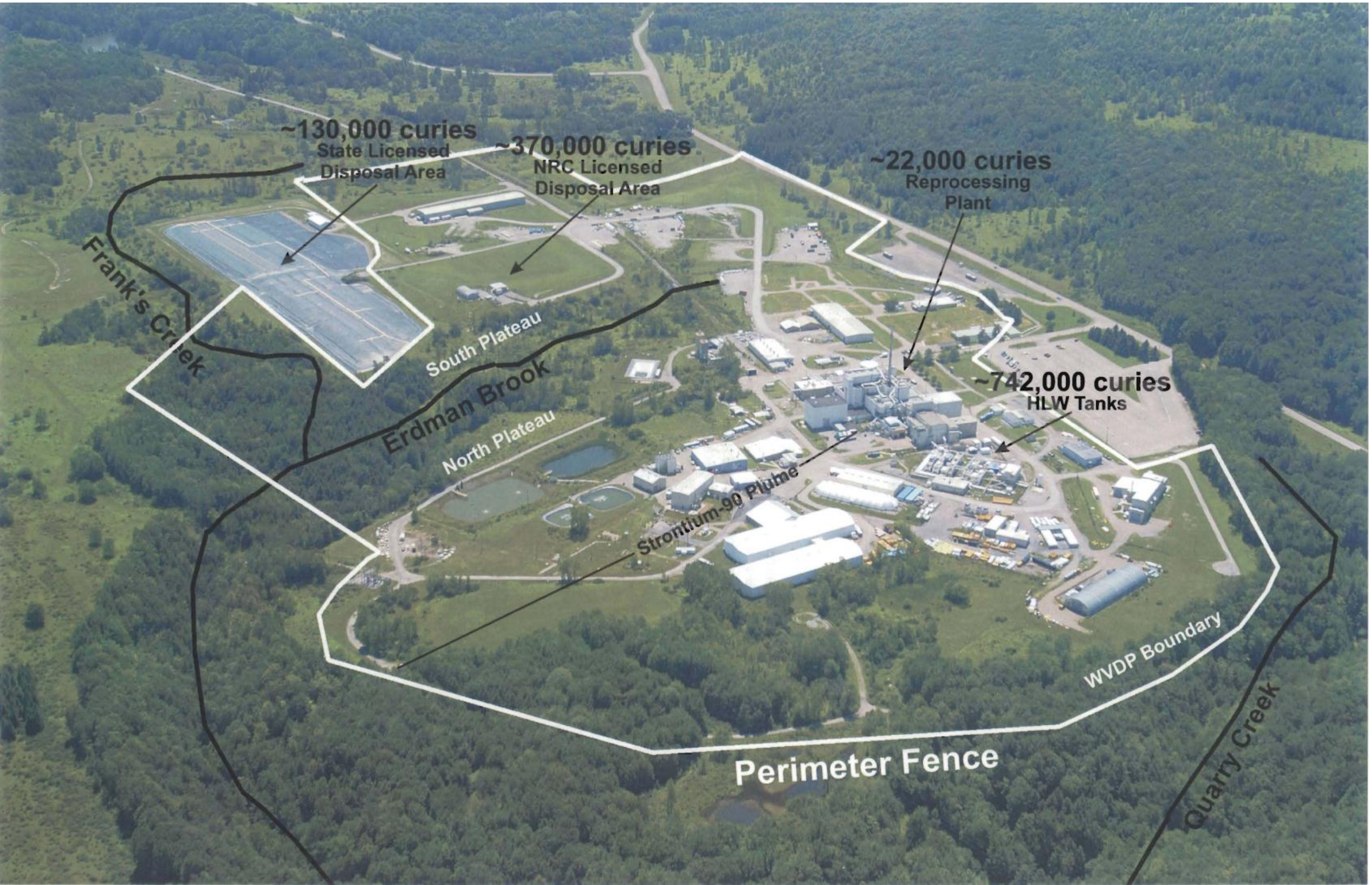


Cleanup efforts – not yet complete – greatly exceed the original West Valley operation

- **Congress passed the West Valley Demonstration Project Act in 1980, signed by President Carter:**
  - **Act based on discussion and recognition of substantial federal role in promoting reprocessing**
  - **DOE to work onsite (90% federal, 10% state funding)**
  - **Solidification and disposal of West Valley HLW, with decon/decommissioning of substantial parts of site**
- **DOE has successfully (and safely) vitrified the HLW in accordance with the Act – but HLW is not yet removed for disposal. *HLW canisters are in the way, need to be moved*.**
- **$2 billion spent to date; $10 billion full cleanup???**

WEST VALLEY SITE

Vitrified HLW (about 15 million curies) is temporarily stored in reprocessing plant

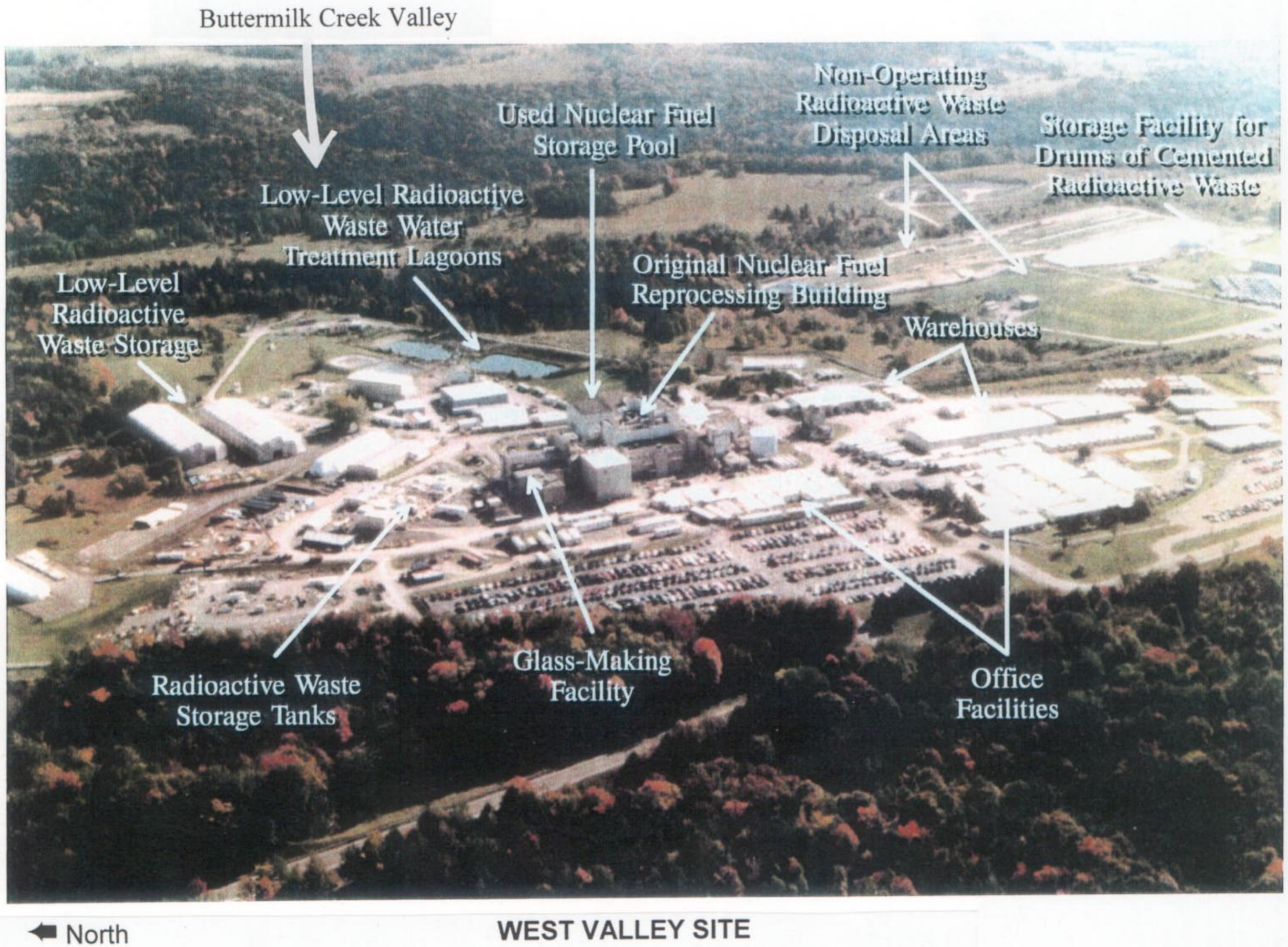


Make the West Valley site an example of successful cleanup

(not an ongoing reminder of unresolved problems)

- **Fully fund site cleanup to protect the Great Lakes environment and public health/safety**
- **For the pending Phase 2 decommissioning decision, *support full site cleanup***
- **Coordinate current Phase 1 decommissioning activities with BRC options for managing HLW**
- **Classify West Valley HLW (275 canisters of vitrified HLW, etc.) as a *priority waste stream for removal to a consolidated interim waste facility*, followed by permanent geologic disposal**

WEST VALLEY SITE



WEST VALLEY SITE

Robert Gillette, *Science* (1974)

"Transient" Nuclear Workers: A Special Case for Standards

Buffalo, New York. For the Buffalo area's unemployed laborers, for the moonlighters, college students, and the young men recruited from small farming towns south of the city, the guarantee of half a day's pay for a few minutes' work was an offer they couldn't refuse. Attracted by the prospect of easy money, they flocked by the hundreds to the Nuclear Fuel Services company between 1966 and the middle of 1972 to perform some of the dirtiest jobs in what one official of the Atomic Energy Commission (AEC) calls "the dirty end of the nuclear business."

The business of Nuclear Fuel Services (NFS) is the chemical extraction of uranium and plutonium from the highly radioactive spent fuel rods of nuclear power reactors. Situated in pastoral, wooded hills 40 miles south of Buffalo, the chemical plant was the nation's first commercial fuel processing facility. Although the technology it used was far from experimental, the NFS plant proved less than a smashing technical success. Almost from the time it opened in 1966 until it ceased operating in June of 1972 (for a major repair and enlargement program to be finished in 1977) the plant suffered repeated breakdowns and leaks of radioactivity. To clean things up and make repairs, the company relied heavily on the Buffalo area's abundant labor pool.

During 5½ years of operation, according to correspondence between NFS and the AEC, the company each year hired an average of 1400 "supplemental" workers from surrounding communities, making up a temporary, continually changing work force that outnumbered the plant's permanent, trained operating staff by more than 10 to 1. With an apparent minimum of instruction in safety procedures and the potential hazards of their jobs, the supplemental men were put to work decontaminating equipment and working areas, burying low-level nuclear waste, and repairing radioactive equipment.

Some of these workers were as young as 18 and others are alleged to have been recruited from bars for an afternoon's work. Some would last a week or more on the job. Others reached legal exposure limits within minutes and were promptly paid off—half a day's pay (at around $3 an hour)—and replaced, in the derisive phrase of a former full-time employee, by "fresh bodies."

On the average, according to AEC inspection reports, the plant's temporary workers received a whole-body radiation dose of 1.73 to 2 rems, an amount not considered harmful, but the equivalent nevertheless of five chest x-rays. This is less than the maximum the AEC allows for full-time radiation workers but much more than the industrywide average of 0.2 rem per year and more than the 0.5 rem allowed for members of the general public.*

The temporary workers, like the plant's permanent staff, also were exposed to small airborne concentrations of plutonium and other radioactive fission products whose hazards are under debate (*Science*, 20 and 27 September).

At one time the plant and its radioactive effluents were the focus of environmental protests, but these objections largely subsided, first as waste treatment improved and later when the plant closed. The company's public relations efforts have generally been effective, and a predominantly blue-collar region now seems to regard NFS as a welcome source of jobs. Local opposition to a planned tripling of the plant's capacity thus have been limited to a handful of conservationists and a few families whose sons worked at the plant. It is expected to reopen in about 3 years, at which time, AEC officials say, the plant will be much cleaner. If it isn't, one official adds, "we're in trouble."

Dormant as it is right now, the NFS plant provides a particularly vivid example of a common and long-standing practice in the nuclear industry. The AEC has long condoned the use of

* Federal radiation protection guidelines in force since 1960 recommend that individuals in the general population receive no more than 0.5 rem per year of nonmedical radiation to the whole body. Nuclear workers are limited to 5 rems per year, but the guidelines allow a worker to accumulate unused exposure according to the formula $5(n-18)$ where n is his age. The worker may draw on his "body bank" at a rate up to 3 rems per quarter or 12 rems per year.

BRH NERHL 70-2

LIQUID WASTE EFFLUENTS from a NUCLEAR FUEL REPROCESSING PLANT

NERHL

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

WEST VALLEY-DERIVED RADIONUCLIDES IN THE NIAGARA RIVER AREA OF LAKE ONTARIO

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Abstract. The presence of West Valley-derived radionuclides in the densely-populated Niagara River/Lake Ontario region is demonstrated through measurements on water and sediment samples. The ^{137}Cs profile in a ^{210}Pb-dated Lake Ontario sediment core is consistent with the pattern of West Valley discharges to the local aquatic environment in that the observed ^{137}Cs activity maximum corresponds to the 1970 peak discharge and not the 1963 fallout peak activity. Preliminary mass balance estimate, based on a ^{137}Cs/^{90}Sr activity ratio of 1.5 and on the assumption that the dominant regional flow of Lake Erie transports most of the radionuclides to Lake Ontario va the Niagara River, shows that nearly all of the West Valley-delivered ^{137}Cs is deposited in the bottom sediments of Lake Ontario. It is suggested that any accidental releases of radioactivity from the site are likely to provide additional radiation dose to the area residents using municipal water supplies.

1. Introduction

The pollution of the densely-populated Niagara River/Lake Ontario region is a topic of major concern. The salient features of the area pollution by toxic organic compounds (Kaiser, 1974) and heavy metals (Thomas, 1972) are continually being defined (Durham and Oliver, 1983; Mudroch, 1983). The existence of several nuclear facilities in the drainage basin (IJC, 1979) leads to the possibility of contamination of this area by radioactive materials as well. By far the most toxic radioactive materials are stored at the Western New York Nuclear Service Center (WNYNSC), located at West Valley, N.Y. The site comprises the first commercial nuclear fuel reprocessing plant in the United States and various storage, treatment and burial areas for radioactive wastes. Although no fuel has been reprocessed since 1972, releases of controlled amounts of radioactive wastes to the local drainage system have continued (NYSDEC, 1967–1982). The average 1969–1971 ^{90}Sr levels resulting from such releases to the adjoining Cattaraugus Creek, which empties into Lake Erie, exceeded both the U.S. Environmental Protection Agency's standard for drinking water and the U.S. Nuclear Regulatory Commission's technical specifications for the creek (IJC, 1983). Besides controlled releases, the possibility also exists that radioactivity may be accidentally released to the local aquatic ecosystem. Indeed, in 1976, rising waters in two trenches had broken through their soil cover (Ecker and Onishi, 1979). Although much information has accumulated concerning the levels of radioactivity around the WNYNSC (NYSDEC, 1976–1982; Ecker and Onishi, 1979; Onishi *et al.*, 1981), the same cannot be said about the fate of West Valley radionuclides following their entry into Lake Erie and possible, but as yet uncharacterized, transport to Lake Ontario via the Niagara River. Bowen

Water, Air, and Soil Pollution **37** (1988) 111–120.

WEST VALLEY PLUTONIUM AND AMERICIUM-241 IN LAKE ONTARIO SEDIMENTS OFF THE MOUTH OF NIAGARA RIVER

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(Received April 14, 1988; revised September 12, 1988)

Abstract. Recently deposited fine-grained sediments in Lake Ontario off the mouth of Niagara River contain highly toxic ^{238}Pu, ^{239,240}Pu, and ^{241}Pu (^{241}Am) from global fallout as well as from low level releases of these radionuclides from the West Valley radioactive waste management site. This is demonstrated through sediment core radionuclide inventories, radionuclide activity ratios, and assignment of independently-derived ^{210}Pb dates to sediment core segments. Reasonable agreement between measured and calculated inventories, derived using various assumptions and available discharge and environmental monitoring data, suggests that nearly all of the West Valley-delivered ^{239,240}Pu and ^{241}Am resides in the bottom sediments of Lake Ontario, comprising about 36 and 80%, respectively, of the measured (1982) inventories of these radionuclides. The West Valley ^{241}Am is largely derived from the decay of ^{241}Pu and, assuming negligible further deliveries of ^{241}Pu (^{241}Am), its growth is expected to continue until about 2040.

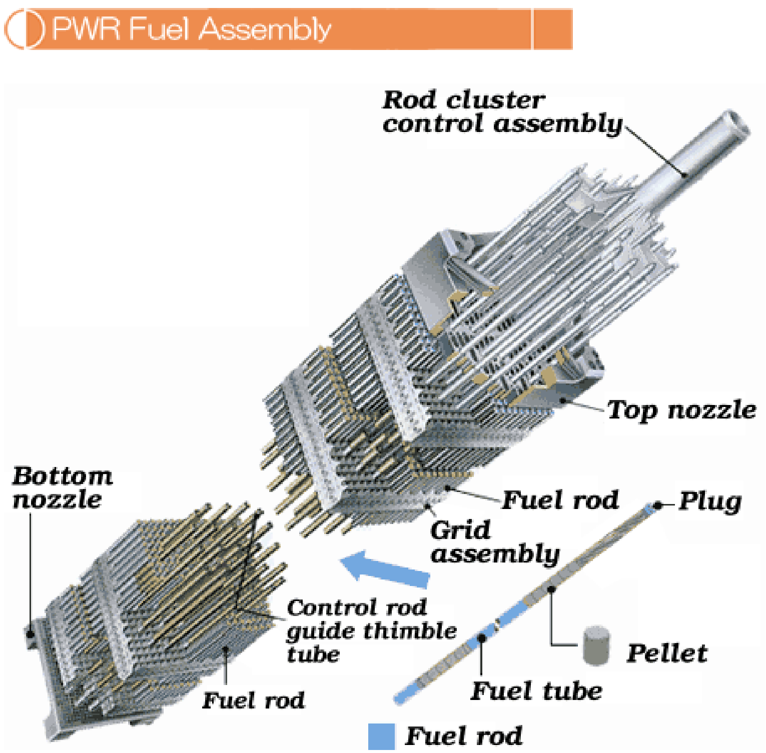
1. Introduction

The Western New York Nuclear Service Center (WNYNSC), located at West Valley, NY, U.S.A. comprises the first commercial nuclear fuel reprocessing plant in the United States and various storage, treatment and burial areas for radioactive wastes. Although no fuel has been reprocessed since 1972, releases of controlled amounts of radioactive wastes to the local drainage system have continued (NYSDEC, 1967–1982). Ecker and Onishi (1979) and Onishi *et al.* (1981) have studied the local aquatic system extensively and have reported the presence of West Valley-derived radionuclides near the confluence of Cattaraugus Creek and Lake Erie. The pertinent section of the eastern end of Lake Erie is a high-erosion area and is characterized by bedrock and coarse grain sediment. There is no deposition of fine-grain sediment which is usually responsible for transporting the bulk of contaminants. Recently, it has been shown (Joshi, 1988) that the dominant flow of Lake Erie waters transports WNYNSC-derived radionuclides for deposition in the bottom sediments of Lake Ontario. A mass balance estimate showed that nearly all of the West Valley-derived ^{137}Cs is present in Lake Ontario sediments. The present communication reports the inventories and depth profiles of highly toxic ^{239,240}Pu and ^{241}Am in Lake Ontario sediment cores and examines the relative contributions of West Valley discharges and nuclear weapons testing fallout to the observed profiles. Bowen (1974) and Breteler *et al.* (1984) have previously reported on the transuranic ratios in the contiguous sections of the area sediment cores but have not assessed the relative contribution of each source. The results presented in this study clearly show that the area sediments are significantly influenced by transuranic discharges from the West Valley site.

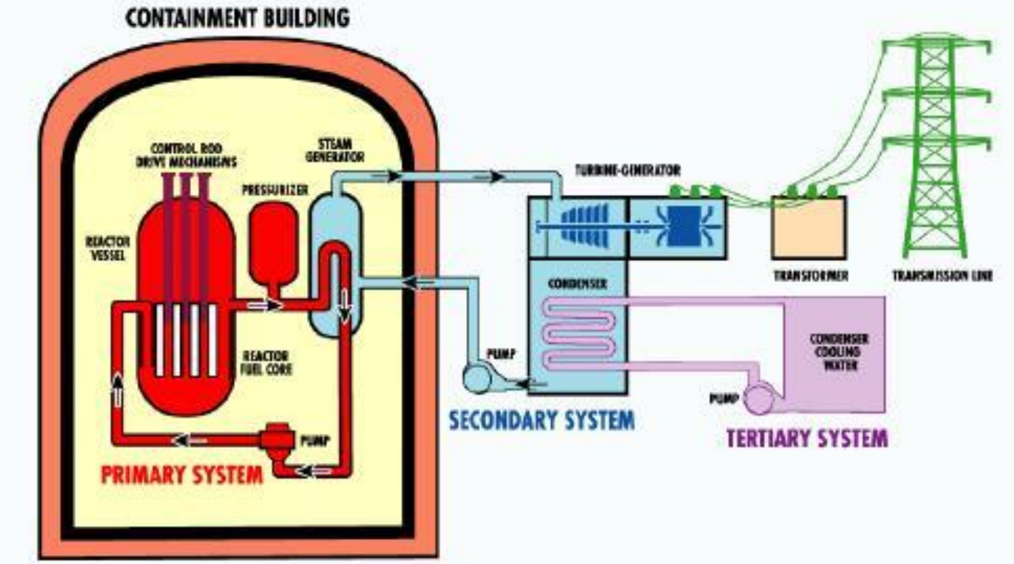
Water, Air, and Soil Pollution **42** (1988) 159–168.

NUCLEAR FUEL

NUCLEAR REACTOR



A fuel assembly consists of a square array of 179 to 264 fuel rods, and 121 to 193 fuel assemblies are loaded into an individual reactor. After the nuclear fuel is used at nuclear power plants, it can be reused as recycled fuel through chemical processing at a reprocessing plant.



Sources: www.mnf.co.jp/pages2/pwr2.htm, www.reachingcriticalwill.org/resources/factsheets/fuelcycle.html

FRESH FUEL

U-238

U-235*

U-238

or (if MOX fuel)

U-238

U-235*

U-238

Pu-239*

>>>>>>>>>>

NUCLEAR FISSION (atoms split, heat is generated)

>>>>>>>>>>

"SPENT" FUEL

U-238 (4.5 B yr)

U-235* (700 M yr)

Pu-239* (24 K yr)

I-129 (15.9 M yr)

I-131 (8 days)

Cs-137 (30 yr)

Sr-90 (29 yr)

Tc-99 (212 K yr)

etc., etc.

*Fissionable

Radioactive half-life in blue

“SPENT” FUEL

U-238 (4.5 B yr)

U-235* (700 M yr)

Pu-239* (24 K yr)

I-129 (15.9 M yr)

I-131 (8 days)

Cs-137 (30 yr)

Sr-90 (29 yr)

Tc-99 (212 K yr)

etc., etc.

>>>>>>>>>>

Reprocessing

(“recycling”)

(fuel rods are chopped up,

chemically dissolved,

to recover some of the uranium and plutonium)

>>>>>>>>>>

END RESULT

U-238 (recycled)

U-235* (recycled)

Pu-239* (recycled)

I-129 (waste)

I-131 (gone)

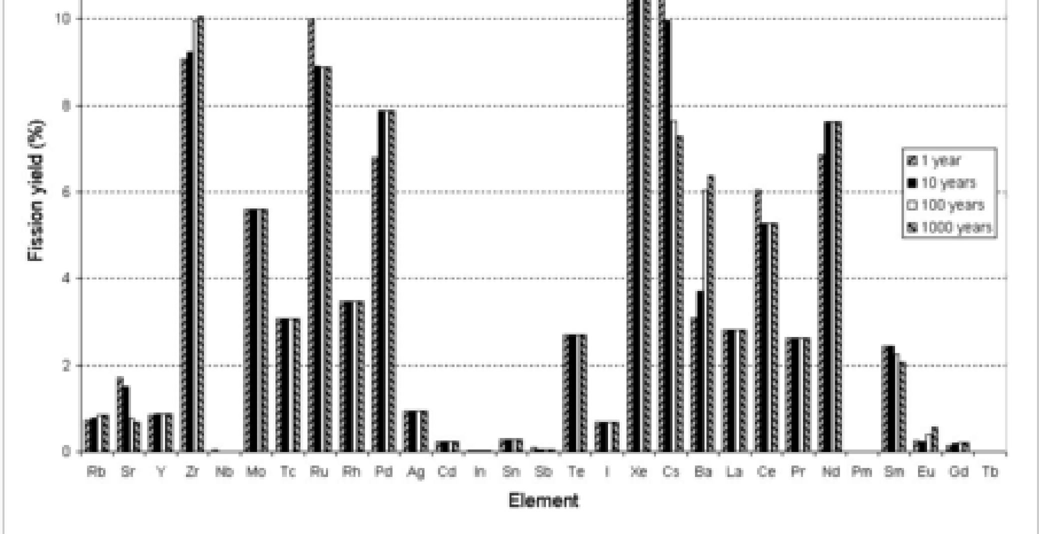
Cs-137 (waste)

Sr-90 (waste)

Tc-99 (waste)

etc., etc.

Yield	Isotope		
0.0508%	selenium-79		
0.2717%	krypton-85		
5.7518%	strontium-90		
6.2956%	zirconium-93		
6.0507%	technetium-99		
0.3912%	ruthenium-106		
0.1629%	palladium-107		
0.0003%	cadmium-113m		
0.0297%	antimony-125		
0.0236%	tin-126		
0.6576%	iodine-129		
2.8336%	iodine-131		
6.7896%	caesium-133 →	caesium-134	
6.3333%	iodine-135 →	xenon-135 →	caesium-135
6.0899%	caesium-137		
2.2713%	promethium-147		
1.0888%	samarium-149		
0.4203%	samarium-151		
0.0330%	europium-155 →	gadolinium-155	
0.0065%	gadolinium-157		



Yields at $10^{0,1,2,3}$ years after fission, probably of Pu-239 not U-235 because left hump is shifted right, not considering later neutron capture, fraction of 100% not 200%. Beta decay Kr-85→Rb, Sr-90→Zr, Ru-106→Pd, Sb-125→Te, Cs-137→Ba, Ce-144→Nd, Sm-151→Eu, Eu-155→Gd visible.

Source: Wikipedia