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NEWS AND COMMENT

Radiation Spill at Hanford: The Anatomy of an Accident

For most of the 7000 workers at the Atomic Energy Commission's vast Hanford Reservation—and for most of the 26,000 citizens of Richland, Washington, Hanford's residential appendage—nuclear energy long ago lost its aura of mystery. They grew up with the atom in a way most Americans did not; they learned to live near, if not exactly to love, potentially hazardous sources of radiation, and they learned to take for granted the strange jargon and paraphernalia of the business—"radwaste," the film badges, the head-to-toe coveralls, the scintillation counters. If nuclear energy meant a mushroom cloud to most Americans, it meant a way of life to those at Hanford.

Nestled in a crook of the Columbia River in a dry, almost empty corner of south-central Washington, the 570-square-mile reservation was the site of one of the three "atomic cities" that the Army built for the Manhattan project. During the war and for 25 years thereafter, great complexes of production reactors and chemical plants (there are nine reactors, all but one of which has been mothballed) turned out tens of thousands of kilograms of plutonium for the nation's swollen stockpiles of nuclear weapons. In the process, the chemical plants also turned out more than 70 million gallons of intensely radioactive liquid waste. The AEC has been slowly evaporating the waste down into solid cakes of salt and storing the cakes in steel tanks; 42 million gallons of the waste are still in liquid form, however. Either way, it remains an exotic legacy of the postwar arms buildup that will have to be guarded for centuries until radioactive decay renders it harmless.

The waste is also an aspect of nuclear energy that Hanfordians have learned to live with quite well. Perhaps because of this necessary accommodation with the atom, and perhaps because spills of radioactive waste are not all that unusual at Hanford, officials of the Atlantic Richfield Hanford Company—the AEC contractor in day-to-day charge of all this nuclear garbage—evinced no signs of urgency in June as hints appeared of yet another spill.

In fact, they kept the bad news to themselves for an entire working day. Having confirmed at a 9 a.m. meeting on Friday 8 June that some of the waste was missing, ARHCO officials waited until 4:25 that afternoon before telephoning the AEC's Richland office and relaying the news: One of the oldest and largest of 151 underground tanks of "high-level" waste was leaking.

No one knew how long tank 106-T had been leaking, or how much of its caustic, boiling contents had seeped into the sandy soil near the center of the reservation. As a matter of fact, no one was certain how much liquid had been in the tank in the first place. Nevertheless, the AEC was advised that emergency pumping operations would begin late that night to salvage what remained in the 533,000-gallon tank.

It was only around noon on Saturday 9 June that federal authorities and ARHCO technicians began to grasp the magnitude of the problem. Picking through what recent records they could find of the leaking tank's contents (a month later, some records were still missing), technicians calculated that the seepage had begun "on or about" 20 April. For 51 days thereafter, roughly 2500 gallons of liquid waste had dribbled out of the steel-and-concrete tank each day; the total loss is estimated at 115,000 gallons, containing 40,000 curies of cesium-137; 14,000 curies of strontium-90, 4 curies of plutonium, and smaller amounts of assorted fission byproducts.

The AEC has methodically and deliberately disposed of far larger amounts of radioactivity in Hanford's soil over the past 25 years, and quite safely, it insists. Other high-level waste tanks have also leaked. Between August 1958, and this June, an estimated 422,000 gallons containing more than half a million curies seeped out of 15 other tanks, all of which have since been "retired." But the leak in 106-T was something different. It was the largest single accidental release of radioactive waste in the commission's history, and easily its most embarrassing incident since Project Baneberry, a weapons test that went awry in Nevada in 1970, sending a puff of fallout all the way to the Canadian border.

Not surprisingly, Hanford's big leak has blossomed into one of the AEC's worst public relations disasters in years. Environmental groups have filed a flurry of lawsuits seeking to stop the flow of wastes from Hanford's two chemical reprocessing plants, and the spill has brought out a rash of frightening headlines up and down the West Coast. On the morning of 5 July, for instance, 22 days after the AEC at Richland issued a press release describing the accident, readers of the Los Angeles *Times* awoke to a six-

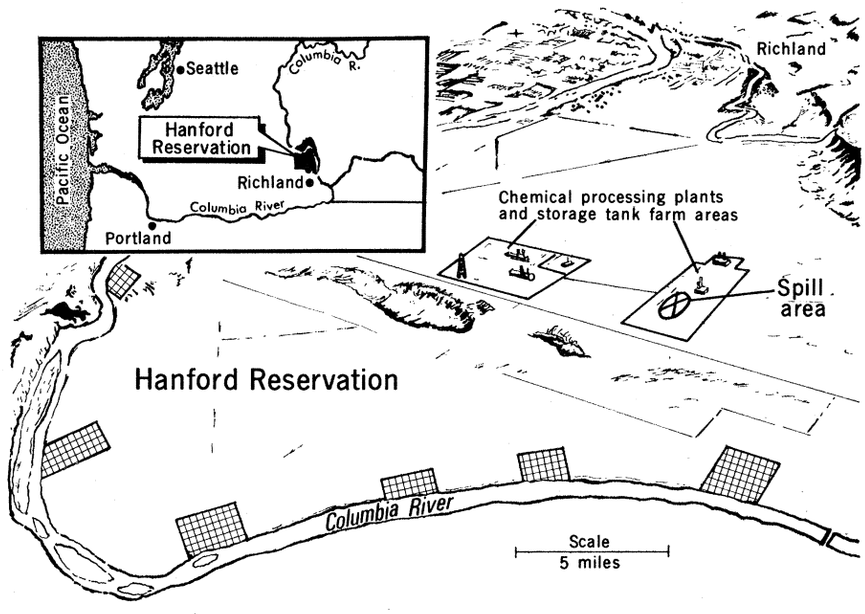
column banner across the front page declaring, "Nuclear Wastes Peril Thousands." Thomas A. Nemzek, the AEC's general manager at Hanford, has even been getting worried letters from his relatives. "They're wondering what's going on," he says. "Are we dropping into a hole, slipping into the sea?"

Whether anyone is actually imperiled is a matter of dispute. AEC commissioner Clarence E. Larson says that he's "distressed at implications that large masses of people are endangered"; as evidence to the contrary, he notes that radioactivity in the Columbia River, downstream from Hanford, is less than half that present naturally in the Potomac River. Nemzek, for his part, contends that no high-level waste has ever reached groundwater at Hanford, and he adds that, even if all the waste stored at Hanford did somehow escape and reach groundwater, radioactivity in the Columbia River would still remain within drinking water standards. In any case, the site's 7000 workers are going about their normal routines, and Richland, at last report, was calm.

More to the point is what the incident reveals about the keenness of the AEC's vigilance over the nation's vast and expanding store of nuclear processing wastes, 75 percent of which are stored at Hanford. Is the AEC really prepared to manage thousands of pounds of wastes that civilian nuclear power plants will be generating in the years ahead? And how, exactly, could it lose the equivalent of a railroad tank car full of radioactive liquid hot enough to boil itself for years on end and knock a Geiger counter off scale at a hundred paces?

The AEC has been asking itself such questions lately, and, with notable candor, is letting the public have a look at the answers. In response to lawsuits filed by the Natural Resources Defense Council and other environmental groups, the AEC has promised to write an environmental impact statement assessing the full range of its waste management programs; it is opening up nuclear waste information centers in five cities; and it is publishing a 1098-entry bibliography of research papers covering storage and disposal of wastes at Hanford from 1951 to the present.

The first real product of this open-window policy is a 129-page report on the causes of June's record leak. The report, written by a four-man committee appointed by Nemzek, attributes the accident partly to aging tanks and primitive monitoring technology, but mostly to managerial laxity and human error on the part of Atlantic Richfield. The report also contains a brief admission that the AEC's Richland operations office, which is supposed to supervise Hanford contractors, failed to detect flagrant deficiencies in management of Hanford's 13 waste storage tank "farms."



Map depicts site of nuclear waste spill found in June at the AEC's Hanford Reservation near Richland, Washington. Hatchured areas denote plutonium production reactor sites. [Kenneth D. Smith]

The bungling attributed to Atlantic Richfield (which has declined to comment on the report) would be unbecoming for a municipal sewage plant, to say nothing of the nation's main repository for nuclear waste. In practice, there are two ways of detecting a leaking tank. While neither method has changed much since the Manhattan Project, they both work passably well if everyone pays attention to his job. For one, tank farm operators were supposed to take weekly readings of fluid levels. Second, they were supposed to take weekly or monthly radiation readings at dry wells spotted around the tanks. If fluid levels sank and radiation in the wells rose, that meant a tank was leaking. Simple, but not fail-safe.

The problem, according to the report, was that the operators who took the readings did not know how to interpret them; and a day shift supervisor in charge of half of Hanford's tanks, who *did* know how to read the data, let 6 weeks worth of charts and graphs pile up on his desk because of "the press of other duties," he said later, and never got around to reviewing them; and consequently a "process control" technician elsewhere at Hanford, who was supposed to be reviewing the tank readings for "long-term trends," received no data for more than a month. The technician, who was not identified, waited until 30 May to complain about the delays, but he nevertheless emerges as the hero in this dismal story. Fragmentary readings of fluid levels in 106-T arrived in his hands on Thursday 7 June, but it was enough to show that something was amiss. The technician put out the alarm; the supervisor confirmed the leak the next morning after checking his records and promptly resigned.

All of this, the report says, led to the discovery of more far-reaching deficiencies that AEC officials had previously failed to notice or fully appreciate. Communications within the tank farm management were chronically poor; there was no "well-defined, formalized training program" for operators and no systematic checking of their qualifications; written and oral instructions to tank operators were neither "consistently applied nor completely understood"; nor was there evidence that supervisors were checking "the operator's knowledge of what he has learned"; no formal preventive maintenance program for monitoring equipment existed; and no evidence

could be found that top-ranking ARHCO officials were paying much attention to the leaky tank farms, in spite of pressure from the AEC to tighten up monitoring procedures and in spite of a "growing number of radioactive leaks," as an ARHCO memorandum from September 1972 puts it.

For all its shortcomings, though, Atlantic Richfield did no more than make the worst of bad circumstances. Monitoring systems were so primitive that, even if everyone had performed up to expectations, between 27,000 and 38,000 gallons of waste would still have been lost. Moreover, the tanks were wearing out (106-T was built in 1943–44, and 108 others still in use are more than 20 years old) and the AEC knew it.

Multiple Warning

Indeed, as if periodic leaks were not sufficient warning, from 1953 to 1971 private consultants, the U.S. Geological Survey, and the Government Accounting Office (an investigative arm of Congress) all had warned the AEC that it was courting trouble by its continuing reliance on the technology of the 1940's to store the nuclear wastes of the '60's and '70's. In the face of this advice, the AEC stepped up its solidification program but turned down requests from Hanford contractors in 1959 and 1961 to build new tanks. (Since then the AEC has built six new tanks and has two more under construction, but has been forced to decommission 25 as confirmed or suspected "leakers.")

One of the first cautionary notes is found in a classified study of Hanford groundwater characteristics, prepared by the U.S.G.S. in 1953. Observing that tank-stored wastes and interconnecting pipelines had occasionally leaked, this report called the tanks a "potential hazard" and concluded that their "true structural life . . . [is] not entirely known." The U.S.G.S. report was declassified in 1960, but was not published in the open literature until this year (as Professional Paper 717).

Nevertheless, on 29 January 1959, the then manager of Hanford chemical plants, Herbert M. Parker, told a congressional hearing on nuclear waste disposal that he confidently expected the storage tanks to remain serviceable for "decades" and possibly for as long as 500 years. Asked whether any had ever leaked, Parker replied that fluid levels in some had undergone "suspicious" oscillations, but that "we are persuaded that none has ever leaked."

A GAO report dated 29 May 1968 tells a rather different story, however. By then, ten tanks at Hanford had leaked 227,000 gallons of waste, all of which was said to be held in the soil beneath the tanks. The first major leak, of 35,000 gallons, occurred in August 1958, 6 months before Parker had testified. Later, the service life of remaining tanks had been reliably estimated at 10 to 20 years. The GAO said structural weaknesses and corrosion were "almost certainly present" in 14 tanks, 4 of which had previously leaked but were still in use. The AEC had apparently ignored the advice of consultants from the Illinois Institute of Technology, who said that some tanks were being stressed "well beyond accepted design limits" and that the wisdom of reusing such tanks was "debatable."

Waste managers at Hanford had little choice in the matter, however. Liquid wastes continued to pour from the reprocessing plants, but the only spare tanks on hand were those with known weaknesses. Between 1963 and 1965, the GAO said, the AEC had found itself in an even less tenable position, with no empty spares on hand. Thus, in November 1963, tank farm operators had watched helplessly from afar as tank 105-A—9 years old, with a capacity of 1 million gallons of high-level waste—sprang a small leak that was later traced to a cracked seam. In full knowledge of this weakness, Hanford continued to use 105-A for the simple reason that there was no other place to put its contents. Indeed, after the initial leak seemed to seal itself, Hanford's waste managers filled it even fuller than before, exceeding the tank's design capacity by 10 percent.

In January 1965 tank 105-A sustained further damage from a powerful internal steam explosion that shook the ground and battered tank instruments. But the tank held, and it remained in use until 1968.

The upshot of the GAO's investigation was an exhortation to the AEC to "devote more vigorous attention" to its waste management problems. The GAO report was classified, stamped "secret" on every page, and remained under wraps until December 1970.* One month later, the GAO made public a follow-up report that cited some progress toward solidifying liquid wastes and phasing out the aging tanks. Taking note of several new leaks, however, the GAO cited an "increased possibility" of still more spills and urged an "increased . . . level of effort" in waste management programs.

AEC officials insist that these criticisms were taken to heart, not ignored. Partly in response, they say, waste solidification programs were stepped up, to immobilize the waste and eliminate the need for tank storage. Technological and funding problems, however, have impeded this effort. In 1968, the AEC expected to have caught up to current waste flows by 1974; now the target date is 1976, although the AEC is thinking about asking Congress for a supplemental appropriation to speed things along.

Civilian Wastes are Different

What does all this have to say about the AEC's ability to handle wastes from civilian power plants? Not much, the AEC says.

"It's an entirely different problem," commissioner Larson said in an interview. "The precautions we take to keep [civilian power plant wastes] from getting into the ground will be much greater than with the defense wastes at Hanford, and our margins of safety will be much greater."

The main difference is that commercial reprocessing plants will solidify reactor fuel wastes almost immediately, before sending them to the AEC for long-term storage.

In the meantime, the incident at Hanford has suggested to the AEC that its allowances for human error may be less than adequate. The commission is looking into waste management practices at its other storage sites, and Hanford claims a heightened vigilance over its troublesome tanks. Liquid levels are now read three times a day instead of weekly; a computerized, automated leak detection system is being rushed to completion; and there is said to have been a "realignment" of sleeping watchdogs in the local AEC office.

In spite of all precautions, though, more spills from Hanford's worn-out tanks are inevitable. Thomas Nemzek said so late in June, and sure enough, on 6 July, yet another one sprang a leak of high-level waste. This time, tank farm crews were alert: They held the loss to 1500 gallons.

—ROBERT GILLETTE

* AEC officials say the report was classified not to avoid embarrassment but to protect information that could be used to calculate rates of U.S. plutonium production. The classification was lifted, officials say, after it was determined to have been "overly cautious."