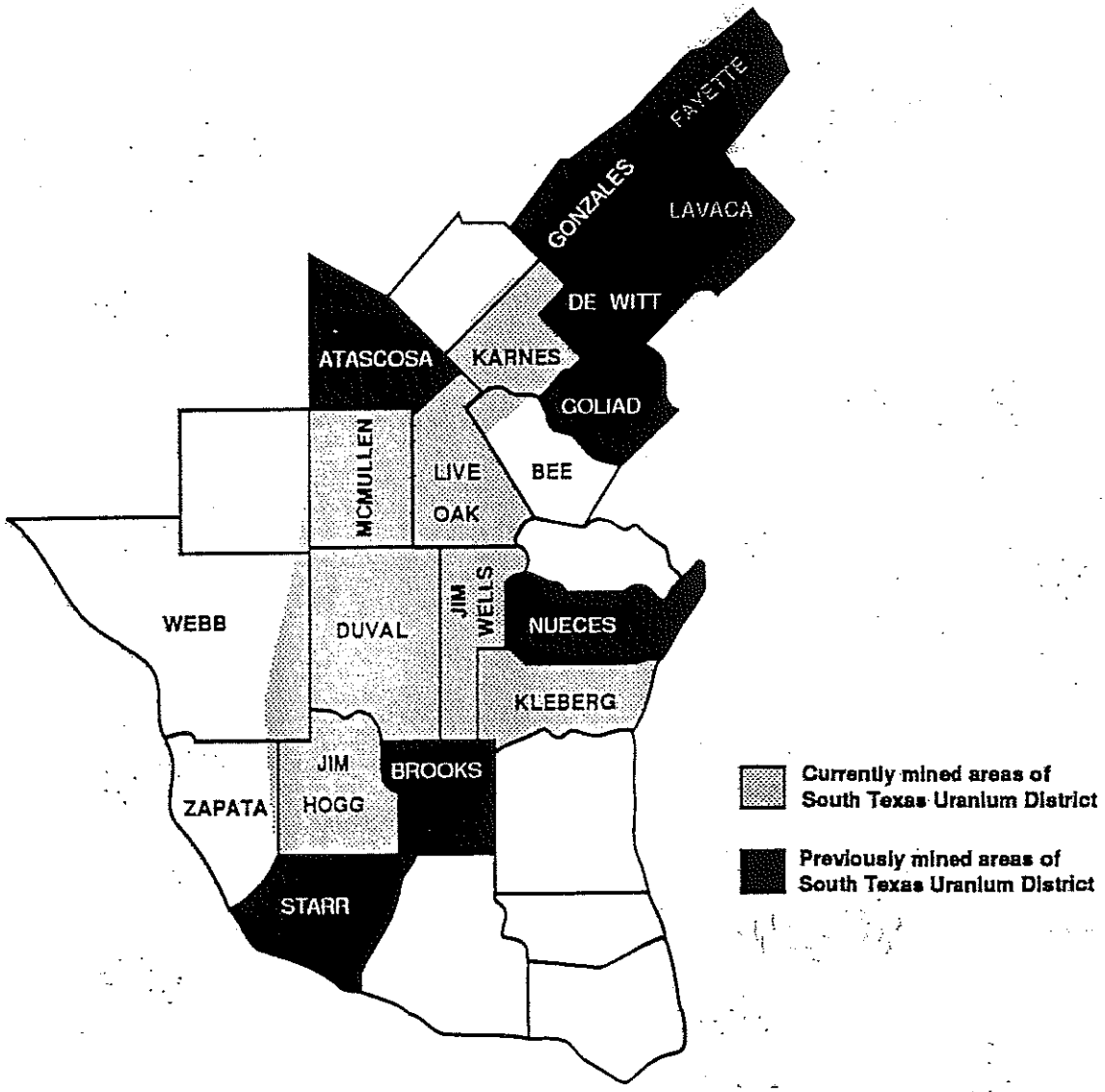
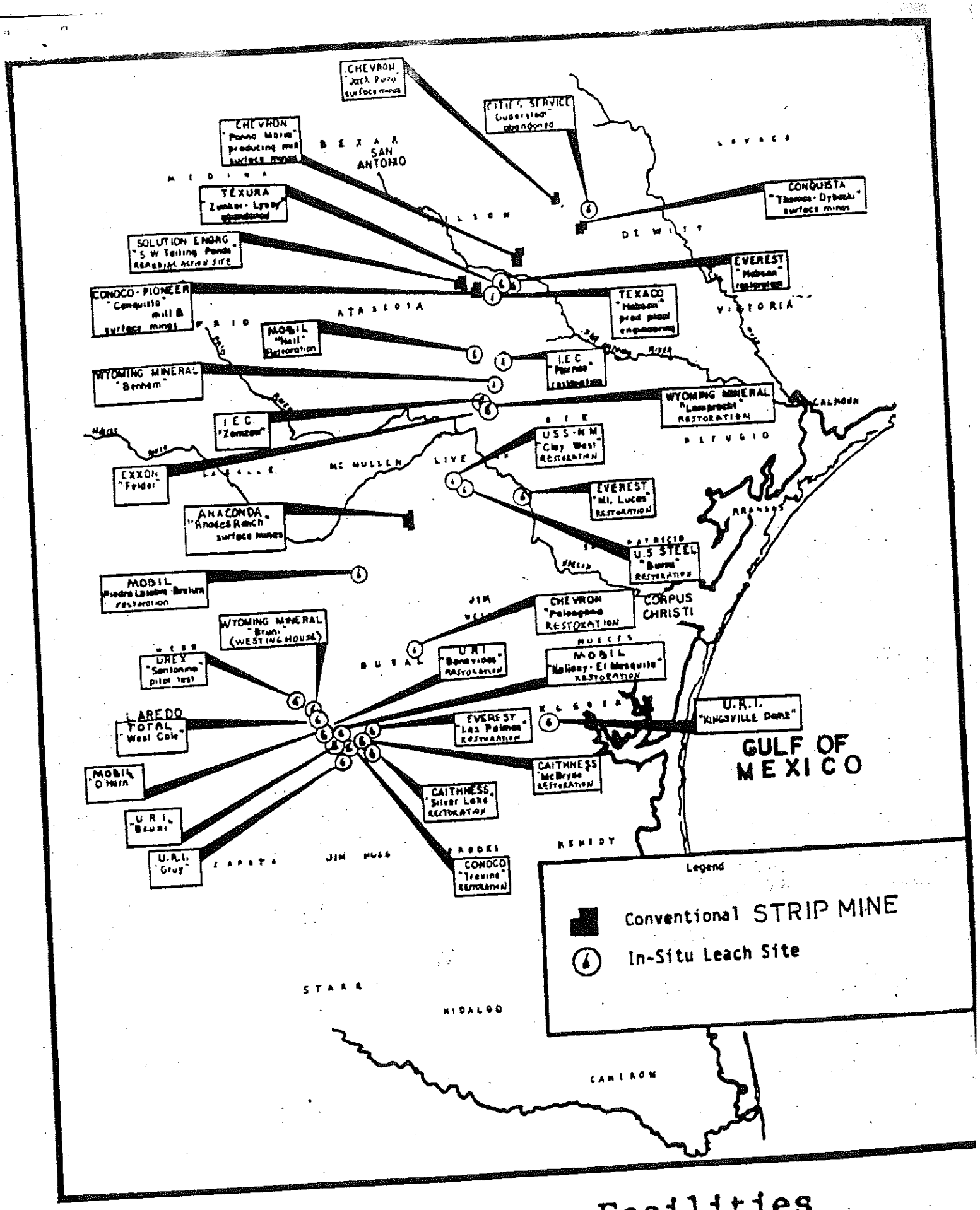
AGRICULTURAL AND RURAL IMPACTS OF URANIUM RECOVERY ACTIVITIES IN THE SOUTH TEXAS URANIUM DISTRICT



DEPARTMENT OF AGRICULTURE



Uranium Recovery Facilities

11. FINANCIAL SECURITY REQUIREMENTS FOR URANIUM MINE AND MILL TAILINGS PERMITS

The Legislature should direct the Texas Department of Health to report on the audited, accountable costs of mill tailings cleanups nationwide to ascertain the amount of financial security that should be required of license holders and to assess the adequacy of current financial security requirements. The report should also evaluate the form of security required in light of the current instability of Texas' financial institutions.

Under existing law, license holders for uranium mines and mill tailings must post financial security sufficient to pay for cleanup and closure should the company go out of business before its site is properly reclaimed.

The amount of financial security commonly required appears to be less than the costs experienced in actual closures. For example, the 240 acre Conoco/Conquista, located in Karnes County, has posted $7 million for closure ($27,083 per acre). Chevron is required to post $6 million for its 160 acre Panna Maria Project in Karnes County ($34,375 per acre). An equivalent site that has already undergone closure is Exxon's Ray Point facility in Live Oak County. Exxon has spent about $2.2 million in closure activities ($55,000 per acre). Ray point had a relatively small 40 acre pond, 15 to 20 feet deep. Although costs do not increase proportionately to the size of the tailings pond, the amounts of financial security required do not seem adequate or consistent, especially as compared to actual experience.

The other site slated for closure is not strictly comparable to the others because of the extent of contamination of adjacent property. The Susquehanna facility near Hobson, Karnes County, has about 90 acres of tailings and will require moving a minimum of 85,000 cubic yards of material.

Table 1: COMPARISON OF CLOSURE COSTS WITH FINANCIAL SECURITY REQUIREMENTS

TAILINGS DISPOSAL SITE	FINANCIAL SECURITY (MILLIONS)	POND SIZE	ACTUAL BUDGETED OR SPENT	SECURITY PER ACRE
Ray Point	$3	40 acres	$2.2	$55,000
Susquehanna *	--	variable due to extensive area contamination	$22	c. $250,000 *
Conquista	$7	240 acres	---	$27,083 **
Panna Maria	$6	160 acres	---	$34,000 **

* Susquehanna is not comparable to the other sites due to the extent of off-site contamination.

** Calculation is based on subtracting the approximate $500,000 contribution to the Radiation and Perpetual Care Fund, which is assumed in calculating security requirements.

The extensive contamination of adjacent properties will require movement of large additional volumes of material. The cleanup is budgeted for $22 million (about $250,000 per acre). See Table 1 for a comparison of financial security requirements.

The adequacy of financial security requirements depends on the stability of Texas' financial institutions. Although the large, national and multinational corporations use their own corporate assets for financial security, smaller uranium producers must use financial instruments such as letters of credit backed by banks. Since the larger companies have been leaving the uranium industry in recent years, the smaller, less secure companies have begun to dominate the industry. Their financial security is only as good as their banks. Should both fail, the state will be saddled with the cost of decontamination, decommissioning, and reclamation, as well as the long term care and maintenance of these facilities.

AGRICULTURE AND THE URANIUM INDUSTRY: A TEXAS DEPARTMENT OF AGRICULTURE STAFF ANALYSIS

From the U.S. Department of Energy's abandoned Susquehanna uranium site to Conoco's Conquista Project, to Chevron's Panna Maria operation, to Everest Exploration's and other companies' *in situ* mining operations, it is clear that South Texas farmers and ranchers live in a very different environment from that of just a few years ago. While the area has always had relatively high naturally occurring background levels of radiation, what is of concern here are the multiplier effects of uranium strip-mining; in-situ mining in drinking water aquifers; spray-irrigation with radioactive wastewaters; open-air storage of radioactive and hazardous materials in tailing piles and ponds; crop cultivation and cattle raising on uranium- and radium-exposed lands; use of radioactive materials in construction; and transportation of ores and uranium products through the area.

Numerous environmental assessments by appropriate federal or state agencies have been done on a site-by-site basis over the last several years. Site-specific assessments are necessary for licensing purposes, and they yield valuable data. Many of those assessments identified problems at the specific sites. However, a public policy review of the relationship between agriculture and the uranium industry requires a broader scope. By bringing together data from site-specific studies and independent investigations, this brief analysis is intended to serve as a beginning, or a prospectus, for a broad policy inquiry by the legislature, appropriate state agencies, and academicians.

Effects on Water

After years of operation and numerous environmental assessments, it is now clear that uranium mining and waste disposal has contaminated South Texas's water. These contaminations include, but are not limited to, the following:

- The U.S. Department of Energy's (DOE) environmental assessment of the Susquehanna site near Falls City indicates that hazardous and radioactive chemicals have leached into the underground aquifer and migrated at least 2500 feet from the tailings piles (U.S. Department of Energy, 1987, pp. 4-5 and 59-63).

- The Texas Railroad Commission's groundwater evaluation of the Conquista site states that "hydrologic, geophysical and hydro-chemical data indicate that seepage of tailings fluids is occurring in the Dubose sands on the east side of the mill tailings pond.... Chemical data suggests an additional area of seepage on the south-west side....Another area where chemical data suggests seepage is on the north side of the pond..." (Texas Railroad Commission, 1987, p. V-40).

• The Texas Department of Health's environmental assessment of the Panna Maria site indicates that holding ponds for hazardous and radioactive chemicals have leaked into the underlying aquifer (Texas Department of Health, 1987b, pp. 56-57).

• Based upon Senator Truan's request for data, and at the request of local landowners, the Texas Department of Agriculture lab services have had surface and well water samples tested from farms near the Conquista, Panna Maria, and Susquehanna sites. The results from the surface and groundwater samples taken around Conquista show alpha and beta levels above the Safe Drinking Water standards, indicating the presence of radionuclides in the water from an undetermined source(s). Test results from samples taken near the other sites had not been received at the time of this writing.

This contamination of South Texas water will likely continue to occur at these and other sites. In-situ mining provides a good example. In-situ mining is a relatively new technology, first developed and tested here in Texas in the 1970s with mining company promises of clean operations. Yet groundwater and surface water contamination is now clearly a part of the package that comes with in-situ mining. In-situ mining operators have not been able to restore the aquifers to their original condition, and are, in some cases, asking for exceptions to the original clean-up requirements.

The growing trend away from deep-well injection of the wastes and towards surface dumping ("spray-irrigation") of the wastes has significant surface water impacts. In its environmental assessment of the in-situ mining operation at Mt. Lucas, TDH concludes that "movement of contaminated sediments downslope into the surface water drainage network [for Lake Corpus Christi] is inevitable" (Texas Department of Health, 1986a, p. 142).

What is to be done about the uranium belt's contaminated water? It should be documented and mapped; then it should be cleaned up, to the extent possible. DOE's Susquehanna restoration project (scheduled to begin in 1990) will set precedents for clean-up efforts at other sites in Texas. DOE has documented groundwater contamination at Susquehanna, but argues that Congress has not funded groundwater restoration, so it does not plan to restore the aquifer to its former condition. DOE's plan is to allow the aquifer to "flush" itself clean, which would take at least a century. The state has apparently accepted DOE's plan.

DOE faces similar problems at 23 other sites that it is responsible for in other states, and does not plan to restore the groundwater at any of the sites. DOE recently responded to Congressional requests by submitting a study on potential groundwater restoration costs at each of the sites. Thus, DOE has now designed a groundwater restoration plan for the Susquehanna site, complete with cost projections, but will not implement it on its own. DOE's preliminary cost estimate for aquifer cleanup at Susquehanna is $348 million--by far the largest estimate of any site DOE is responsible for. The next highest estimate is $114 million; estimates for most sites are less than $10 million (U.S. Department of Energy, 1988, Table A.9). The high cost of the Susquehanna restoration is an indication of how very serious is the groundwater contamination at the site.

Panna Maria residents fear radiation will end way of life

By RICHARD STEWART
Houston Chronicle 10/16/88

PANNA MARIA — Local folks claim the tiny South Texas farming village of Panna Maria is the oldest Polish community in the country.

In 1854, 100 families came from Silesia to build homes and hack futures out of the brush on the low, broad hills 50 miles southeast of San Antonio. For 134 years their farms have passed from fathers to sons while the farmers fought against droughts, floods, financial panics and crop failures to preserve a way of life.

Now some of Panna Maria's farmers fear their way of life may be destroyed by something they can't even see — radioactivity and pollution from a nearby Chevron mill that separates uranium from ore dug from beneath the South Texas soil.

They fear contamination already is setting loose a terrible legacy of cancer and birth defects in their community. Members of a group called Panna Maria Concerned Citizens call for inclusion of their group in future decisions concerning the site, and when the energy giant finally closes the compound in about a decade, they insist, it should leave behind a $26 million bond to ensure proper cleanup.

(Late Friday, townspeople won one of their battles when the Texas Department of Health agreed to allow Panna Maria Concerned Citizens to participate in hearings regarding the facility. Chevron had at first objected to the group's participation, but later capitulated.)

Chevron Resources Co. officials say tests show no harmful contamination has escaped their 2,943-acre facility, which includes a processing mill, an abandoned strip mine and a 160-acre pond where mill wastes, or tailings, are stored.

Turning to state regulators to date has provided little comfort for townspeople.

The health department's Bureau of Radiation Control, which licenses such operations in Texas, has allowed Chevron to operate the plant on extensions since its first license expired in 1980. The bureau says it has no information of any problems at the Panna Maria pro-

ject.

The Texas Department of Agriculture, however, says there are data indicating that contamination is leaking from the tailings pond and that the contamination poses a dire threat to nearby farmers. That department says the Bureau of Radiation Control isn't doing its job of policing the uranium industry.

A Chevron-financed study of 42 monitor wells around the site showed the intrusion of acid and arsenic into some of the wells. Concentrations, however, "have remained below drinking water standards."

After reading the study, Robert J. King, a high-ranking agriculture department official wrote his health department counterparts: "THE PANNA MARIA MILL TAILINGS POND IS LEAKING. The only questions seem to be how badly, and who will bear the cost of contamination and clean-up."

King said his department's staff thinks the health department underestimates the potential for movement of contaminants through the water supply. "We find it difficult to understand why, given the revelation above, why the staff then appears to accept the applicant company's conclusion about the consequences," King said.

"Nobody dies of anything else but cancer around here," said Andy Rives, 34. His wife, Joyce, is the great-granddaughter of one of Panna Maria's founding families.

"There was a cancer in this house, and two brothers who died over there and one here, and two brothers here," neighbor Lailey Sczepanik said as she recalled nine cancer cases in the last four years in homes along the dirt road where she lives.

Only Sczepanik and Rives' households have been free of diagnosed cancer, she said.

"And both our families moved back here less than four years ago."

The Rev. Frank Kurzaj, pastor of Panna Maria's Immaculate Conception Catholic Church, said he's officiated at 13 funerals since he came to the overwhelmingly Catholic community of about 100 last year. Ten of the 13 had cancer, he said.

Kurzaj said he also believes there are more miscarriages in the area than should be normal.

"People don't talk about it," he said. "But one woman says to another one, 'I'm pregnant,' and in a couple of weeks she doesn't say anything more about it and she isn't pregnant any more."

Kurzaj said he doesn't know if the health problems he's seen have anything to do with the Chevron mill. "We need to find out," he said.

Residents of the Panna Maria area have nothing to worry about, the Texas Department of Health has reported.

Newt Millen, an attorney with the radiation control bureau, said that although the plant operation isn't perfect, "They are not in deadly non-compliance."

The health department has continually kept tabs of cancer, birth defect and miscarriage rates in Karnes County and has detected no unusual problems, he said.

Last year, the health department released a study that said that there are fewer cancer deaths per capita in Karnes County than in the rest of the state. "These analyses could not be completed for 1981 through 1985 because of incomplete reporting of cancer cases from this region for this time period," the report said, however.

"This is the kind of thing we're up against," said Mike Trial, a 30-year-old San Antonio Fire Department paramedic and fourth-generation farmer near the Chevron facility. "The health department says there's no indication anything is wrong and they won't go out and get the data to find out if anything is wrong."

Dr. Albert Wood, a Corpus Christi cancer specialist who lives with his wife and eight children several miles from the Chevron site, said the health department's conclusions aren't supported by available data.

"I don't think anyone knows what's going on," he said. Birth and death records are notoriously poor indications of problems with birth defects or cancer because most Karnes County residents go outside the county for major medical care.

If a cancer patient goes to San Antonio, Corpus Christi or Houston for treatment, and dies there, his death is recorded in that county, not Karnes.

There just isn't any information, Wood said. "All we have is anecdotal data.

"The company has been in operation here only 10 years. Usually if you're going to develop cancer, it takes 15-20 years."

It could take three decades for health department records to reflect a problem, he said.

Studying cancer deaths is not the way to find out if there is a problem, said William Au, a research scientist at the University of Texas Medical Branch in Galveston. Au studies the effects of pollution and radiation on chromosomes within the human body.

"The damage may not begin to show up for 10 years down the line," Au said. "I believe those people have been exposed, but we don't know if they have been exposed enough to cause damage."

Au proposes a yearlong study of 50 Panna Maria-area residents and workers in the mill, along with a study of 50 people who never go near the mill, to see if contamination has caused chromosome damage.

"I'm not going to allow anything to happen at this site that would endanger my workers or the residents who live around the site," said mill manager Jay Reynolds.

He said the mill has continually operated within the guidelines of the Bureau of Radiation Control and does everything it can to make the operation as safe as possible. The mill has never been cited for a rules infraction.

"We're not dealing with anything that wasn't here before," mill superintendent Frank Baltrich said.

Indeed, the uranium was there long before the farmers.

Millions of years ago, uranium fell onto the area in the ash from volcanoes that spewed over what is now Mexico and West Texas. It coated sand particles along what was then the Texas coastline and accumulated in pockets beneath — and in some places atop — the soil as the seacoast receded.

After World War II, companies began digging up ore in South Texas.

Chevron began operating the mill in 1979 to process ore from a big open strip mine adjacent to the mill. That mine now has been reclaimed and converted into rich pasture land. Ore now comes from a new mine in McMullen County, 80 miles away.

The ore looks like gray or black sand or sometimes like soft black rocks. Ore is mixed with acid and other chemicals to separate uranium oxide from other minerals.

It takes a ton of ore to make from one to five pounds of uranium oxide. Uranium oxide, called "yellow cake," is shipped to other plants where it is enriched and converted into nuclear power plant fuel pellets. After enrichment and processing, each pound of uranium oxide has the usable energy of 10 tons of coal.

Most of what started out as ore is left behind as tailings — material that is still radioactive and mixed with acid. At Panna Maria tailings are pumped into a 160-acre pond created by a 40-foot-tall dike.

Under the pond is a layer of natural clay that keeps the waste water from getting out of the pond, Reynolds said. The dikes also have clay centers and are tied into the clay layer.

"You go out to your city landfill and you'll find better lining than that," said Vick Hines, staff director of the state Senate Subcommittee on Health Services and an aide to subcommittee chairman state Sen. Carlos Truan, D-Corpus Christi.

Hines said special clays and synthetic liners would be much more effective in making sure nothing leaks out of the Panna Maria pit.

Some of the monitor wells dug to make sure none of the wastes are getting out have shown degradation of the water in some underground water sands. Reynolds contends that the water in the monitor wells is coming from unpolluted fresh water containment areas and is being contaminated as it leaches through natural dry sands.

Chevron is now pumping water out of the wells.

Such efforts are viewed with skepticism by area residents.

Sam Moczygemba, 74, grew up on a farm across a highway from the Chevron plant. His grandfather put in a hand-dug, 100-foot-deep well around the turn of the century.

"That was some fine water in that well," he said. "It made some damned fine home brew, too."

A couple of years after the uranium mill began operation, Moczygemba began to notice that the water smelled and tasted funny.

"Then it got to be that if you washed your hands in it you would get a rash," he said.

Moczygemba contacted Chevron and the company drilled another well a few feet from the first.

"It was the same thing," Moczygemba said. The company drilled a third well 250 feet away.

"It's bad, too," Moczygemba said.

Mill manager Reynolds said he thinks water from the third well is fine to drink, but said he wouldn't advise Moczygemba to drink it until he has it fully tested. Moczygemba said it still gives him a rash to wash with water from the newest well.

"We poured some of the water from it out on the soil," he said, "and it killed the grass."

Tilley Foegelle, who has land on the other side of the mill, said she worries about the cattle she keeps there. Widowed with four small children in 1956, she kept her family going on profits from the cattle she raised.

"You count on those calves," she said.

In recent years, however, many of her calves were born horribly deformed, she said.

"Their little legs will be all twisted up," she said. She said she's tried different breeds of cattle and different bulls. Nothing seems to work.

"We moved back here from San Antonio because we were worried about crime," Trial said. "We wanted to raise our children out here where we were raised. Now I stay awake at night worrying that I might have moved them into something that was much worse."

Sen. Truan's aide Hines said: "These people are not alarmists. They have been around the uranium industry for a long time and they're not afraid of it. They just want it to be done properly."

The Karnes County citizens already know about problems.

Legislature appropriated $2.2 million to be combined with $18.8 million in federal funds to pay for a leaking tailings pond at the old Susquehanna uranium operation near Falls City.

But the cleanup won't include groundwater, which the U.S. Department of Energy estimates may be contaminated for a half mile around the site. It would cost $348 million to clean up the aquifer, a DOE report said.

When Chevron gets ready to close its tailings pond, the company will cap it with a layer of clay and soil and will plant it. Chevron is responsible for monitoring the site and maintaining it for five years, and after that title of the land and responsibility for the site go to the state.

Chevron will give the state a one-time payment of $250,000 in 1978 dollars for the perpetual upkeep of the site. Panna Maria residents say that payment should be raised to $26 million.

One of the biggest problems with controlling uranium milling in Texas is that the Bureau of Radiation Control is a pro-industry advocacy agency that is in business to assist the much-needed uranium mining industry, Hines said.

Truan said legislators are considering taking power to license milling operations away from that agency, but hasn't decided which agency should replace it.

Millen said the bureau was overwhelmed in the late 1970s by applications for new licenses for uranium mining operations. Relicensing of existing operations was put on hold while new licenses were being considered, he said.

"It's like sending a coyote to watch the chickens," Rives said. "We feel like the Bureau of Radiation Control is working for Chevron."

"We don't want to shut Chevron down, we just want to make them

URANIUM: The Real Facts

A medical response to the Marline Corporation's *Uranium Fact Book*

By Dr. Eve Bargmann
Health Research Group
PublicCitizen

$2.00

URANIUM: The Real Facts

About the Authors

Eve Bargmann is a physician practicing in Washington, D.C. She is a board-certified specialist in internal medicine. For the past two years, her work has included research into consumer health issues, including safety and effectiveness of prescription and non-prescription drugs, health care delivery, consumer access to medical information, and occupational safety and health.

The Health Research Group is part of the Washington-based non-profit organization **Public Citizen.** Founded by Ralph Nader and Dr. Sidney M. Wolfe in 1971, the Health Research Group is nationally known for its work in research and advocacy on health issues. It has been active in many areas of public health interest, including safety and effectiveness of drugs and medical devices, health care delivery, food safety, and occupational safety and health.

Copies of this booklet are available for $2.50 each (post-paid) from the following organizations:

Public Citizen's Health Research Group
2000 P Street, NW #708, Washington, DC 20036

Public Citizen's Critical Mass Energy Project
P.O. Box 1538, Washington, DC 20013

STOP Uranium Mining in Virginia
SR. #3 Box 380, Rochelle, Va. 22738

Contents

Introduction

Many residents of Virginia have been asking serious questions about the effect uranium mines will have on their land, their water, and their health. This booklet is an answer to the *Uranium Fact Book* distributed by the Marline Uranium Corporation in an effort to encourage uranium mining in the Virginia Piedmont. The so-called *Uranium Fact Book* answers real concerns people have about uranium mining with a collection of half-truths, opinions, and misleading statements.

To set the record straight, *Uranium: The Real Facts* outlines what doctors, scientists, and U.S. Government study groups have found out about the effects of uranium mining and milling on workers and the environment. We hope Virginians will use this information to look more closely at Marline's self-serving "facts."

Uranium Mining in Virginia: The Unanswered Questions

The Marline Uranium Corporation wants to open uranium mines in the Virginia Piedmont. It has already spent over $6 million searching for uranium in Virginia.

The people of Virginia have raised serious questions about the effect of uranium mines on nearby land and water and the danger to people who live close to uranium mines. So far, Marline's attempts to answer these questions have not been reassuring.

Virginians are not the only people asking tough questions about uranium mining. Over the past few years concern about its environmental and health effects has led to political action in areas in North America that have been faced with mining.

In February 1980, Canada's British Columbian legislature imposed a seven- year moratorium on all uranium exploration and mining in the province. In March 1980, 34 Vermont towns voted to prohibit uranium mining nearby. Vermont law now forbids uranium mines in the state unless specifically approved by the state legislature. In 1981, the New Jersey state legislature passed a seven-year moratorium on exploration and mining of uranium after many towns called on it to act.

Citizen concern is justified. Careful scientific studies of the effects of radiation in general and uranium mining in particular have shown that:

- There is no known "threshold" radiation dose that is safe. Exposure to *any* radiation, no matter how little, carries some risk.

- Radiation exposure causes many different kinds of cancer. It can cause leukemia, breast cancer, thyroid cancer, and lung cancer. It also causes genetic damage, which may result in birth defects and miscarriages.
- Radiation exposure adds up. Each new exposure adds to the lifetime radiation dose and increases the risk of cancer.
- Lung cancer is a great danger to people who work in uranium mines. Radioactive gases in the mines, called radon daughters, expose the lung to large doses of radiation. As a result, uranium miners are five times as likely to die of lung cancer as are non-miners. Lung cancer has already killed hundreds of American uranium miners.
- Levels of radioactive gases (radon daughters) in uranium mines are dangerous. The National Institute for Occupational Safety and Health (NIOSH) has found that at levels of radon daughter exposure now allowed by the Occupational Safety and Health Administration (OSHA), a miner's risk of lung cancer is more than doubled. NIOSH considers this a "major public health concern."
- Uranium mills produce millions of tons of solid and liquid waste. The solid wastes, called tailings, remain radioactive for hundreds of thousands of years. The Nuclear Regulatory Commission (NRC) describes radiation released from these tailings as "the largest potential routine releases from the nuclear fuel cycle."
- Uranium mines, mills, and tailings have contaminated water supplies in several areas — sometimes permanently. Radioactive wastes, sulfuric acid, lead, arsenic, and other chemicals produced by uranium mines and mills can escape into rivers or groundwater and pollute them beyond all human use. For example, fish are no longer present in 55 miles of rivers and lakes downstream from the uranium mills in Elliott Lake, Canada.

- Although the Uranium Mill Tailings Radiation Control Act of 1978 requires some cleanup of tailings piles, this law is not being enforced at active mills. NRC's 1982 funding appropriation prohibits it from enforcing these standards.
- Current methods of "cleaning up" mill tailings are far from guaranteed. NRC describes the effectiveness of synthetic liners that are supposed to prevent waste seepage as "questionable at best." And Virginia, which has more rainfall and shallower groundwater than other sites for uranium mills, is particularly vulnerable to groundwater contamination by tailings.

Uranium mining poses serious risks to Virginia's people, its water, and its land. Virginians need to know the truth about these risks before Marline opens its mines. They do not need a so-called "Fact Book" that plays down or ignores the risks of uranium mining.

From now on, this booklet will quote Marline's claims directly from the *Uranium Fact Book*. After giving you Marline's "facts," we'll look at the *real* facts.

The Risks of Radiation

A. RADIATION EXPOSURE: NATURAL BACKGROUND RADIATION

The Mining Company's "Facts":

Man has always been subjected to natural radiation. (p. 8)

The Real Facts:

All people — men, women, and children — are exposed to small amounts of radiation. But this does *not* mean that radiation is safe. No amount of radiation, no matter how small, has been shown to be safe.

Exposure to radiation has been linked to many serious and life-threatening health problems. One effect of radiation exposure is cancer — leukemia, bone cancer, breast cancer, lung cancer, cancer of the thyroid gland, and other cancers. Another effect is genetic damage — serious birth defects in children. High doses of radiation also cause many other problems, among them, cataracts; loss of the body's defenses, which makes exposed people more susceptible to infections; inability to have children.[1]

The danger of radiation exposure depends on the dose you receive. The higher the dose, the greater your risk of serious health effects.

Some radiation exposure — such as that from cosmic rays — is unavoidable. But other far greater radiation exposures can be decreased significantly or avoided entirely. To protect our health, we need to focus our attention on these avoidable sources of radiation exposure.

The chart below shows some sources of radiation exposure and the average dose an American receives from this exposure.[2]

Unavoidable Radiation	Average Yearly Dose in U.S. (millirems*)
Natural Background Radiation	82
Fallout from Past Weapons Tests	4-5

Avoidable Radiation (in millirems*)	Average Yearly Dose to Those Exposed (mrems*)	Average Yearly Dose in U.S. (in millirems*)
Medical Radiation (diagnosis)	122	91
Dental X-rays	3	1
Brick and Masonry Buildings	7	3-4
Medical X-ray Workers	260-350	0.4
Dental Office Workers	50-125	0.05
Uranium Miners— Lung Dose	up to 40,000	

**For an explanation of radiation doses (millirems, rems, rads, etc.), see the glossary, p. 37.*

As this chart shows, the currently allowed radiation dose for underground uranium miners far exceeds the natural background radiation level. Even using the highest estimates of natural background radiation to the lung, 420 mrem per year, underground uranium miners' exposure amounts to *95 times this level.*

Uranium ores contain dangerous and very long-lived radioactive chemicals. Buried deep in the earth, they do little or no harm when left alone. But uranium mining brings them to the surface, where they can contaminate our air, water, and food.

One group of radioactive chemicals in uranium ores, called radon daughters, contaminates the air. When you breathe these chemicals, they irradiate the lungs. They are extremely damaging; one rad of these radioactive chemicals produces as much lung damage as 10 to 20 rads of X-rays. Hundreds of uranium miners have already died from lung cancer caused by exposure to radon daughters.[3]

Since it is radioactive and unstable, uranium breaks down into other radioactive chemicals; once released by uranium mining and milling, they endanger people in different ways. Underground uranium miners risk lung cancer from their exposure to radon daughters; workers in uranium mills risk cancer of the lymph glands. People living nearby are endangered when radioactive ores and mill tailings (wastes) contaminate air and water supplies; the added radiation increases their risk of cancer and genetic damage.

The Mining Company's "Facts":

Stone and brick houses would expose their occupants annually to more radiation than the 25 mrem limit [near uranium mills]. (p. 17)

URANIUM AND ITS RADIOACTIVE BY-PRODUCTS[4]

Chemical	Half-Life*
Uranium^{238}	4.5 billion years
Thorium^{234}	24 days
Protactinium^{234}	1 minute
Uranium^{234}	250,000 years
Thorium^{230}	80,000 years
Radium^{226}	1,620 years
Radon^{222}	3.8 days
Polonium^{218}	3 minutes
Lead^{214}	27 minutes
Bismuth^{214}	20 minutes
Polonium^{214}	.00016 seconds

These four chemicals, called radon daughters, have been linked to lung cancer in uranium miners. They are present in high concentrations in underground uranium mines; they are also found in uranium mill tailings.

Lead^{210}	19.4 years
Bismuth^{210}	5 days
Polonium^{210}	138 days
Lead^{206}	stable

**The half-life is the time it takes for half of a given amount of a radioactive substance to decay. As it decays, it becomes the next chemical on the list, until it turns to the stable end-product, lead.*

The Real Facts:

Living in a brick or masonry house increases your radiation exposure by only 7 mrem per year.[5]

B. RADIATION EXPOSURE: MAN-MADE SOURCES

The Mining Company's "Facts":

Our annual exposure to radiation also includes those relatively recent sources which we voluntarily accept or share due to modern life. These man-made sources of radiation consist of medical care, personal habits, air travel, and occupational exposure, and many other accepted aspects of the normal day. (p. 8)

The Real Facts:

To "voluntarily accept" a risk, we need to *know* that a risk is present and have some idea *how great* that risk is. We can then choose whether the benefits of a thing or action are worth the risk it entails.

Most people are not aware of all the sources of radiation they face and do not know how to protect themselves. We have not "voluntarily accepted" the continuing radiation exposure from weapons testing fallout. And employers usually do not fully inform workers about dangers in the workplace.

Uranium mines, for example, are dangerous workplaces. Under current standards workers can be exposed to 4 WLM of radiation each year, or 120 WLM over a lifetime — enough to double their risk of dying of lung cancer.[6] Yet the Marline Corporation, which plans to run uranium mines in Virginia, claims in its book that radiation in mines "does not now pose a significant health hazard to miners"!

C. RADON AND RADON DAUGHTERS

The Mining Company's "Facts":

Radon only becomes a problem when it is trapped in a confined space where it might be inhaled in an appreciable amount. Proper ventilation eliminates this problem. (p. 10)

The Real Facts:

This statement is extremely misleading.

Radon itself is not the most dangerous product of uranium decay. Radon breaks down into radioactive chemicals called radon daughters, which become fixed to tiny particles in air. When people breathe this radioactive air, it irradiates and damages their lungs.

As for "proper ventilation," adequate workplace controls could reduce the risk to uranium miners considerably. But while today's underground mines do have some ventilation, they are not risk-free.

For many years underground uranium mines were very poorly ventilated. This exposed miners to high levels of radioactivity — and a very high risk of lung cancer. As a result, hundreds of uranium miners died of lung cancer.

When the U.S. government set standards for workplace radon daughter exposure, the mining companies improved ventilation in underground mines. Even then, however, they tried to cut corners on safety. Instead of using ventilation primarily to reduce the risk to workers, some mines used ventilation to deceive U.S. government inspectors. While inspectors were measuring radiation levels in one area, the mine owners shunted radioactive gases into another area of the mine. In 1979, Robert B. Lagather, Assistant Secretary for Mine Safety and Health, reported:

> During the audits that were conducted over the past two years, we determined that it was necessary to have more than one inspector present at the mine during the inspection. This made it impossible to adjust ventilation from one area of the mine to another to satisfy the inspector while allowing another area to experience increased radiation levels.[7]

In other words, mine operators were using ventilation to conceal from inspectors the amount of radiation to which workers were actually exposed. This may "eliminate this problem" for the mine operator, but it does just the opposite for the worker. Adequate ventilation is extremely important — but today's mines have a way to go before workers' problems are eliminated.

D. TYPES OF RADIATION IN URANIUM MINES

The Mining Company's "Facts":

Alpha radiation will just penetrate the surface of the skin. It can be stopped by a sheet of paper. (p. 11)

The Real Facts:

Uranium decays to form the radioactive gases radon and radon daughters. These gases give off alpha radiation, a form of radiation that does a lot of damage within a short distance.

When radioactive chemicals that give off alpha radiation (called alpha emitters) stay outside the body, their effects do not go farther than the skin. But when you inhale alpha-emitting radon daughters, they damage the lung and airways directly. This radiation damage can lead to lung cancer.

The Mining Company's "Facts":

These gamma rays are not a radiation hazard for the public, even from highly concentrated uranium ores. (p. 11)

The Real Facts:

Gamma rays are a form of radiation with effects similar to those of X-rays. Like X-rays, gamma rays penetrate the body. And like X-rays, gamma rays have harmful effects such as genetic damage and cancer.

While gamma rays are not the most dangerous form of radiation in uranium mines, they *are* present and *do* add to the health risk. In the King Solomon Mine, for example, workers are exposed to up to 2.3 rads per year of gamma radiation, twenty times the natural background radiation exposure.[8] Their risk from this radiation exposure adds to the risk they already face from breathing radioactive radon daughters.

In a report on the risk of lung cancer in uranium miners, the National Institute of Occupational Safety and Health (NIOSH) points out that uranium miners may receive up to 5 rems a year of gamma radiation in addition to their alpha radiation exposure from radon daughters. The report concludes:

> an incremental dose from exposure to gamma radiation, e.g. 1-2 rems per year, may contribute significantly to the total lung dose to be evaluated over a miner's lifetime.[9]

E. RADIATION: ADDING UP THE RISKS

The Mining Company's "Facts":

According to Dr. Bernard Cohen of the Nuclear Physics Department of the University of Pittsburgh, the radiation levels in energy efficient homes are only about five times lower than in a uranium mine. In about 3% of these homes, the radon exposure is actually greater than in a uranium mine. It is possible that a miner could receive a higher exposure level in the home than in the mine. (p. 14)

The Real Facts:

Radiation levels in most houses are very low. Studies have found these levels to range from 0.004 to 0.01 Working Levels (WL).[10] In uranium mines, on the other hand, workers' exposure may legally average over 0.3 WL, or 30 to 75 times the level in a house.[11]

Well-insulated houses are likely to have higher levels of radon daughters than are better ventilated houses. Dr. Bernard Cohen has estimated that good insulation in an energy-efficient home will increase radon daughter levels to 2.5 times their current level.[12] This would bring exposure levels to 0.01 to 0.025 WL. Energy-efficient homes, in other words, still have radiation levels less than one-tenth those in uranium mines.

The other important fact here is that radiation exposure adds up.[13] If a uranium miner goes home to a house with high radiation levels, that miner's risk of lung cancer is even higher because of the double exposure. Medical and dental X-rays, radioactive contamination of air, water, and soil by uranium mill tailings, and radiation exposure at work all add to background exposures to increase the danger.

No level of radiation exposure is known to be safe. For this reason, it is important to avoid all preventable exposure to radiation.

Uranium Mining: The Risk to Workers

A. LUNG CANCER IN URANIUM MINERS

The Mining Company's "Facts":

In the past, the absence of proper ventilation and other modern mining techniques permitted relatively high concentrations of radon to accumulate in the early underground uranium mines. Some published statistical analyses indicate a possible correlation between exposure levels and incidence of lung cancer. However, statistical studies of this early period did not adequately consider the effects of other non-radioactive influences such as dust or diesel fumes in early uranium mines and these studies also did not accurately take into account smoking habits as an influence on lung cancer rates. (p. 23)

The Real Facts:

Uranium miners 20 to 30 years ago did have higher exposures to radioactive substances than miners face today. They also had very high rates of lung cancer.

Of 3,366 people working in underground uranium mines between 1950 and 1964, 144 had developed lung cancer by September 1974. Only 29.8 lung cancer deaths would have been expected in a comparable group of people who were not miners; so miners ran 4.8 times the risk of lung cancer because of their work in uranium mines.[14] By 1978, Dr. Joseph Wagoner estimated that 205 of these miners had died of lung cancer — 165 more than would be expected in this group. The miners' risk of dying of lung cancer was over five times as great as that of non-miners.[15]

While cigarette smoking also increases the risk of lung cancer, it does not explain the many lung cancer deaths in uranium miners. Non-smoking uranium miners face a higher lung cancer risk than other non-smokers. And uranium miners who smoke also develop more lung cancers than smokers who do not work in the mines.

Some facts on the risk to non-smokers come from studies of Native Americans, who smoke much less than do whites. Archer *et al* followed 780 Native American uranium miners from 1960 to 1973. Eleven died of lung cancer; only 2.6 deaths would have been expected. Four of the eleven who died did not smoke; of the others, none smoked over a pack a day.[16]

Gottlieb and Husen looked at all Navajos admitted to the Shiprock Indian Health Service Hospital with lung cancer between 1965 and 1979. Of 17 Navajos with lung cancer, 16 were uranium miners. 14 of the 16 miners with lung cancer did not smoke.[17]

In 1979, Lundin *et al* studied the risk of lung cancer in uranium miners who did and did not smoke. They found that, even after correcting for their smoking habits, uranium miners had an extremely high risk of lung cancer — almost four times the expected risk. Miners who smoked under a pack a day and those who were past smokers had the greatest increase in risk. But all miners, regardless of how much they smoked, faced an increased risk of lung cancer because of their exposure to uranium mines.[18]

Cigarette Smoking Classification	# of Lung Cancer Deaths	# of Lung Cancer Deaths Expected in This Age and Smoking Classification	Relative Risk Due to Uranium Mining
Non-Smokers	2	0.52	3.8
Past Smokers	5	0.31	16.2
Smokers of up to 1 Pack Daily	38	6.4	5.9
Smokers of Over 1 Pack Daily	17	9.2	1.8
Total	62	16.4	3.7

C. THE LATENT PERIOD: CANCER STRIKES YEARS AFTER EXPOSURE

The Mining Company's "Facts":

Dr. Robert Buechley, an epidemiologist at the University of New Mexico Medical School, in his own study on Grant's Uranium Belt miners, reports that no miner who began work after 1961 has contracted lung cancer [as a result of increased radiation levels due to uranium mining]. (p. 24)

The Real Facts:

Cancer takes years to develop. For example, asbestos definitely causes many kinds of cancer, including lung cancer and a rare cancer called mesothelioma. Yet a survey of many asbestos workers found that:

> No mesotheliomas were seen less than 15 years from onset of exposure [to asbestos], and comparatively few

> in less than 15-25 years from onset. Similar observations obtained for lung cancer. . . With but few exceptions, serious risk begins after 20 years from onset of exposure and continues from that point on.[19]

The same holds true for uranium. Workers exposed to uranium do not develop cancer until 10-25 years or more after they are exposed. For Native American miners who do not smoke, this delay, or latent period, averages over 20 years.[20]

Because of this known delay, scientists have not even studied miners who began work after 1964. Studies of people who worked in uranium mines from 1950 to 1964 found an extremely high risk of lung cancer in these miners. But studies of people exposed less than 18 years ago have yet to be done.

Since doctors have not looked yet for cancers in these workers, they, needless to say, have not found them. But after the latent period has elapsed, those miners who have had significant radiation exposure since 1964 can also be expected to develop radiation-induced cancers.

C. TYPES OF LUNG CANCER IN MINERS

The Mining Company's "Facts":

Finally, published results of tissue diagnosis for deceased uranium miners do not support the assertion that radon exposure levels were the principal cause of cancer in earlier underground uranium miners. (p. 24)

The Real Facts:

Tissue diagnosis studies show just the opposite. The type of cancer most often linked to cigarette smoking is called squamous or epidermoid cancer. In uranium

miners, on the other hand, other types of cancer are increased as well.[21] The result has been a pattern that does not allow mining companies to simply blame cigarette smoking for miners' cancers.

One form of cancer found in many uranium miners is small cell undifferentiated or oat cell lung cancer. Twenty percent of all lung cancers are of this type.[22] Yet of fifteen Navajo uranium miners with lung cancer, ten (67%) had small cell, undifferentiated, or oat cell cancers.* [23] Other studies have also found relatively more of this type of lung cancer in uranium miners.[24]

Tissue diagnosis, in other words, links uranium mining to all kinds of lung cancers. It does *not* support the uranium industry book's claim that smoking and other factors are the real culprits.

* Navajos smoke much less than do whites. Most of the lung cancer victims in the Navajo study did not smoke.

D. CURRENT EXPOSURE LEVELS ARE UNSAFE

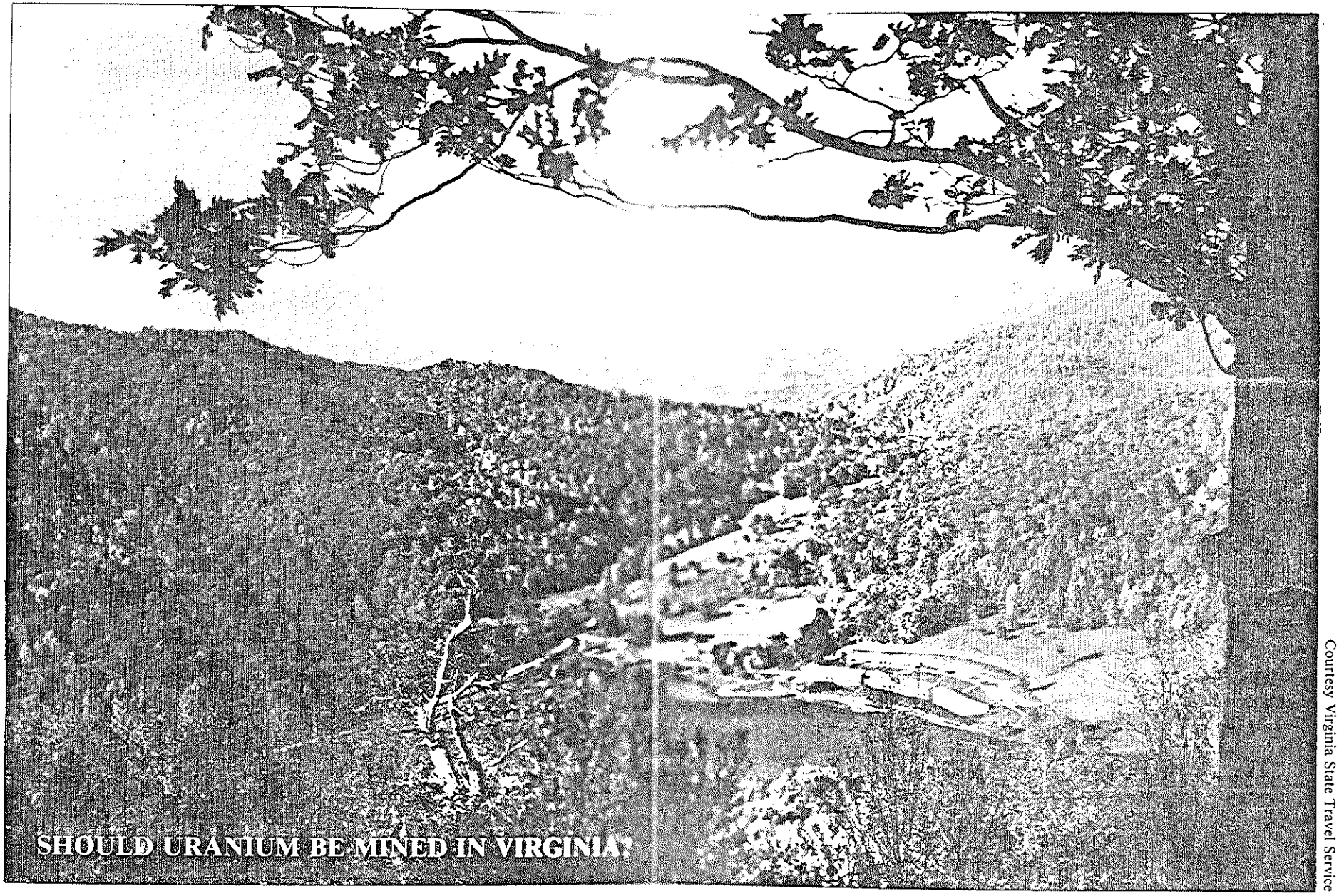
The Mining Company's "Facts":

With the low exposure levels established in Federal standards, radon gas does not now pose a significant health hazard to miners. (p. 13)

The Real Facts:

Uranium miners in underground mines face a high risk of lung cancer. Of 3,366 uranium miners studied from 1950 to 1978, 205 died of lung cancer; only 40 such cancer deaths were expected. Their risk of lung cancer was five times as great as that of non-miners.[25]

While radiation levels are lower in uranium mines today than they were in 1950, they are far from safe. At



Courtesy Virginia State Travel Service

radiation levels now accepted in uranium mines, a miner can be exposed to 120 WLM of radiation in 30 years of work.[26]

120 WLM of radiation exposure is a dangerous dose. In a study of Canadian uranium miners, Hewitt found their risk of lung cancer increased even at exposures under 120 WLM. All the miners exposed to less than 120 WLM had significantly more lung cancer deaths than did non-miners.[27] According to the NIOSH study group, this study "provides direct evidence of a substantial lung cancer risk at levels of cumulative exposure lower than those found in the U.S. studies and upon which the U.S. standard was derived."[28]

Another study looked at uranium miners in Czechoslovakia. The NIOSH study group reports that in this study,

> A significant excess of lung cancer was demonstrated among these uranium miners at each cumulative exposure category down to and including 100 to 149 WLM. An approximate doubling of the lung cancer risk was also demonstrated at each of the two lower cumulative exposure categories (under 50 and 50-99 WLM). . .[29]

In other words, radiation exposures that are perfectly legal in U.S. mines today have been linked to a doubling of the cancer rate in miners.

The NIOSH study group warned:

> This leads to the conclusion that there is no margin of safety associated with the present standard. The estimates also provide supporting evidence that miners of uranium-bearing ores are at higher risk of cancer than other individuals occupationally exposed to radiation when the allowable limits, expressed as dose, are evaluated comparatively.[30]

The Mining Company's "Facts":

Extensive research has indicated there are no health effects for underground uranium miners if radon exposure does not exceed 120 WLMs in a lifetime — a standard established by international agencies, and enforced in the uranium industry. (p. 13)

The Real Facts:

As explained above, uranium miners exposed to radiation levels *within federal standards* run twice the risk of dying of lung cancer. A recent study found that even at levels as low as 15 to 45 WLM, a miner's risk of lung cancer relates directly to the degree of exposure to radon daughters.[31]

The NIOSH study group concluded that:

> At these levels of exposure [under 120 WLM] an excess risk of lung cancer mortality is evident (greater than two-fold) and of sufficient magnitude to be of *major public health concern* [emphasis added].[32]

The Marline Corporation apparently views a doubled risk of cancer death as "no health effects."

How well the uranium industry obeys even this inadequate standard is also questionable. The NIOSH report gives the following records of recent worker exposures to radiation in uranium mines, as found by the Mine Enforcement and Safety Administration (MESA)[33]:

Year	Average Exposure (WLM) Claimed by Companies	Average Exposure (WLM) Found by MESA Inspectors
1975	1.07	5.68
1976	0.99	4.64
1977	0.91	4.08

In each year, the actual worker exposure was over four times that claimed by mining companies — and the *average* worker exposure was *above* 4 WLM, the highest exposure allowed by law.

A further audit by MESA confirmed that "uranium miner exposure was significantly greater than indicated by operators' records."[34] Since the average levels recently recorded were still 4 to 5 WLM per year, these miners still face lifetime radiation exposures that will significantly increase their risk of dying of lung cancer.

The Mining Company's "Facts":

Concerning the low levels of radiation experienced by miners today. . . the literature which states that low-level radiation by radon daughters give [sic] rise to increased incidence of cancer is in my opinion not supported by fact. . . (p. 14)

The Real Facts:

This "opinion" is not true for underground uranium miners. The fact is that levels of radon daughters accepted as the "safe" legal limit in uranium mines today can more than double the miners' risk of lung cancer.[35]

The Mining Company's "Facts":

Exposure to gamma radiation in these mines has been found not to be a problem, although measurements are routinely made. (p. 14)

The Real Facts:

Current standards limit miners' exposure to gamma radiation to 5 rems per year (45 times the normal background radiation), *in addition* to exposure from radon daughters.[36] The NIOSH report found that "an incremental dose from exposure to gamma radiation, e.g., 1-2 rem per year, may contribute significantly to the total lung dose to be evaluated over a miner's lifetime. . ."[37] The NIOSH group, in other words, *did* find that gamma radiation in mines was a problem.

E. WORKERS ARE STILL IN DANGER

The Mining Company's "Facts":

Worker's disease rates [in uranium mines] are no more than what is found in the general mining population. (p. 24)

The Real Facts:

Exposure to 120 WLM of radon daughters over a worker's lifetime (4 WLM a year, the currently allowed level of exposure in uranium mines) doubles a worker's risk of developing lung cancer.[38] While workers may be just as healthy when they start to work in uranium mines, the picture is likely to be quite different after 30 years. Uranium miners followed to date have certainly suffered major health problems — such as hundreds of needless deaths from lung cancer — because of their work in the mines.

F. URANIUM MILLING

The Mining Company's "Facts":

In August 1980, the NRC issued a Draft Regulatory Guide defining health physics monitoring surveys to be implemented by companies for protecting uranium mill workers from radiation and the chemical toxicity of uranium while at work. (p. 26)

The Real Facts:

Marline's book does not address the risk to uranium mill workers. But these workers may also be at risk.

Many radioactive chemicals that result from uranium's decay can be present in the air in mills.

One study looked at workers in uranium mills from 1960 to 1967. Four workers died of lymphatic system cancers; only one death would have been expected. The fourfold increase in risk of these cancers was statistically significant.[39]

Uranium Mill Wastes: The Tailings Problem

A. URANIUM MILL TAILINGS: DANGER TO PUBLIC HEALTH

The Mining Company's "Facts":

Full stabilization of uranium tailings can be achieved and is required under the Federal Uranium Mill Tailings Radiation Control Act. While government agencies require and companies believe it is prudent to isolate mill tailings, no study generally accepted by the scientific community has shown a correlation between these tailings piles and disease rates in communities which are near tailings disposal sites. (p. 27)

The Real Facts:

Unlike the Marline Corporation, experts on radiation are extremely concerned about the dangers of uranium mill tailings. The sheer volume of these radioactive wastes, — 144.5 million tons in 1977 and even more now — makes them a major public health threat.[40]

Uranium mines bring large amounts of very radioactive ores to the earth's surface. Mills remove only a small fraction of these ores, leaving 85% of the radioactivity there.[41] Radium, thorium, and uranium remain in the ores; and they decay to produce radioactive gases, including radon and its daughters. The U.S. General Accounting Office reports that:

> radium is the most significant radioactive waste product in the tailings. It has a very long radioactive life, taking thousands of years before it loses its radioactivity. This loss — called radioactive decay — produces two distinct

> types of hazards. The first type is highly penetrating gamma radiation. Exposure to sufficient amounts of gamma radiation can cause cancer, such as leukemia. The second hazard — radon gas — produces other radioactive products which attach to particles in the air and are deposited in the lungs when inhaled. Exposure to large concentrations of these radon products can increase the risk of lung cancer.[42]

Radiation exposure can cause many kinds of cancer, including leukemia and cancer of the lung, breast, and thyroid gland.[43] Genetic damage may also result from radiation exposure.[44] The U.S. General Accounting Office has estimated that just five of the abandoned tailings piles in the U.S. will cause 321 preventable cancer deaths over the next 100 years if they are not cleaned up.[45] And the Nuclear Regulatory Commission (NRC) warns:

> radioactive releases from existing mills constitute the largest potential routine releases from the nuclear fuel cycle.[46]

How great a danger uranium mill tailings pose depends to a large extent on how many people are exposed to them. Dr. Emery A. Johnson, then Assistant Surgeon General, wrote in 1979:

> Threat of the uranium mill tailings was documented in the Ford, Bacon, and Davis-Utah reports conducted for the Energy Research and Development Administration. The total threat from the mine waste remains to be determined and depends a great deal on the presence of a population group for exposure.[47]

In the relatively well-populated Virginia Piedmont, these wastes could threaten many people with the risk of excess cancer and genetic damage.

B. WATER CONTAMINATION

The Mining Company's "Facts":

In the case of uranium, the Uranium Mill Tailings Radiation Control Act effectively eliminates the potential of seepage to groundwater by requiring that liners be placed under and covers over the tailings. These liners must be of natural low-porosity and/or synthetic materials designed to prevent seepage of all contaminants including these metals — radioactive and nonradioactive — into surface or ground waters. (p. 30)

The Real Facts:

Wastes from uranium mills in the U.S. and Canada have repeatedly and sometimes severely contaminated nearby water. In Elliott Lake, Canada, fish are no longer present in one half the total watershed of the Serpent River, 55 miles downstream from the uranium mine there.[48] In lakes downstream from these mines,

> the water has either partially or entirely been replaced by radioactive and contaminating mining wastes...It should be noted that almost all of the currently affected streams and lakes once had an abundance of aquatic life and excellent tourist and recreational usage.[49]

Contamination continues in this area even from the most modern mills:

> Contaminated waste spills, breaks, accidents continue through the years and are probably best illustrated with a brief summary of occurrences in the last few months. On October 20th, 1979, a tailings line leading from the new panel mill to the waste disposal area broke resulting in liquid and solid contamination to Quirke Lake. The Panel operation is purported to represent the newest, most modern uranium facility in Canada and as a mat-

> ter of fact, only entered production in 1979. In addition to the foregoing, frequent breaks and spills have often left the mill itself knee-deep in slimes and process which have also escaped to the outside environment and entered the lake...
>
> On November 24th, 1979, between one and two million gallons of contaminated flows bypassed the recently installed treatment facility entering Moose Lake and entered the Serpent River system.[50]

United States mills have also polluted the waterways. For example,

> tailings and other wastes from the uranium mill at Durango had severely polluted the Animas River. Downstream in New Mexico,...the towns of Farmington and Aztec depended on the Animas for drinking water and farmers looked to it for irrigation water...[51]

Accidents, too, are a constant threat. On July 16, 1979, a weakened earthen dam broke near United Nuclear Company's uranium mill at Church Rock, New Mexico. Over 300 million gallons of radioactive and acidic waste spilled from the dam and contaminated the Rio Puerco River. The spill threatened both the health and the livelihood of nearby residents, Navajo sheep farmers.[52]

Experts on uranium mill wastes do not share Marline's confidence that current technology will protect people living near mills from danger. The Nuclear Regulatory Commission (NRC) has made it clear that in areas with average or above-average rainfall, lining materials for tailings piles cannot be trusted to prevent radioactive wastes from seeping into groundwater. Since mills operating now are in dry areas in the West, the NRC has not set stringent standards to prevent seepage. It explains:

> There is concern about providing good seepage control primarily during the operational period when hundreds of tons of waste solutions are generated daily at an average mill...There is good reason to expect that there is, in general, little recharge of aquifers in interfluvial zones in the *semi-arid* milling regions, if there is any at all. *It is for this reason that the NRC has accepted use of synthetic liners, the likely long term stability of which is questionable at best.*[53] (emphasis added)

The NRC was assuming that even if the liners failed, contaminated groundwater would not reach the deep aquifers (underground water supplies). Since Virginia's groundwater is often found in shallow open spaces, known as fractures, this water is likely to be particularly vulnerable to contamination by seepage. The NRC reports:

> Some commenters noted that spread of seepage contamination can occur rapidly by fractures...Experience has indeed shown this concern to be valid.[54]

Water supplies near uranium mines, mills, and tailings piles are and continue to be in danger of contamination. While the Uranium Mill Tailings Radiation Control Act, if enforced, should reduce this danger, its protections are probably inadequate for the Virginia Piedmont. And the Act certainly does *not* "effectively eliminate the potential of seepage."

C. TOXIC METALS AND OTHER WASTES

The Mining Company's "Facts":

It has been stated that the levels of toxic metals in tailings, including arsenic, molybdenum, lead, and

selenium will cause as many problems for the environment as radiation. It is usual for trace amounts of these metals to be present in the residue of most mining operations...

The NRC requirements will prevent entrance of these substances into the food chain or environment. Because of these regulations, potential contamination of groundwater from these substances is eliminated in uranium mining. (p. 30)

The Real Facts:

Uranium mill wastes (tailings) include other dangerous substances in addition to radioactive wastes. A single uranium mill in Canada, during its nine years of operation, dumped into a nearby lake the following wastes:

—7,200 tons of uranium
—2,700 curies of Radium 226
—450,000 tons of sulfuric acid (106 tons a day).[55]

Lead, one of the chemicals found in mill tailings, can cause permanent brain damage in children and nerve damage in adults, as well as other serious or fatal kinds of poisoning.[56] Another waste chemical, arsenic, has been linked to cancer of the lung, vocal cords, and skin.[57] Sulfuric acid discharge from uranium mills in Canada has made one nearby lake as acid as vinegar.[58]

What is worse, a uranium mill's toxic wastes remain dangerous forever. And as the above discussion of water contamination makes clear, presently available cleanup methods can't even promise to prevent wastes from seeping out now — much less over the next five thousand years.

D. TAILINGS CLEANUP: IS IT RELIABLE?

The Mining Company's "Facts":

Reclamation of the tailings disposal area is an integral part of satisfying the Nuclear Regulatory Commission license requirements for the operation of a new uranium mill. The disposal options are: above grade, below grade, near the surface, or far below grade. Below grade disposal will be required wherever practicable. Soil compaction at the site, emplacement of liners and covers of natural or synthetic materials, or both, plus selection of appropriate covering vegetation such as grass is required. Proper design and construction of the tailings reclamation area will effectively eliminate any off-site contamination. (pp. 30-31)

The Real Facts:

The radioactive wastes in uranium mill tailings are extremely long-lived. This makes safe disposal of these dangerous wastes particularly difficult. The NRC acknowledges:

> the inescapable fact that the tailings will, in fact, remain hazardous for extremely long periods of time, hundreds of thousands of years.[59]

The NRC also admits that present methods cannot claim to "eliminate contamination" for such long periods:

> attempting to provide assurances that the tailings, which are very large volume, low-specific activity wastes, will remain completely isolated for infinite time frames is impracticable and inappropriate...[60]

A report by the U.S. General Accounting Office also

questions the adequacy of current cleanup methods. It says:

> A DOE contractor, in its assessment of each of the 22 inactive mill tailings sites, stated that it reviewed all present methods, technology, and research data on uranium mill tailings site stabilization. It found that much research and development remains to be performed before complete stabilization of radioactive mill tailings can be realized. In particular, the contractor found that (1) reasonably effective means of wind and water erosion control are available, although they will involve continued maintenance costs; and (2) possible methods exist for the control of leaching. Up to this time, however, no attempt has been made to contain radon in a tailings pile. Although a thick earth cover is theoretically effective, it has never been attempted.[61]

A report from the Los Alamos Scientific Laboratory also casts doubt on the adequacy of current tailings cleanup methods. NRC now asks mills to cover tailings with 3 meters (around 10 feet) of ground. Yet the laboratory warns:

> Our result indicates that 12 feet of clay are required to reduce radon exhalation by 99% and the remaining 1% is still about four times the typical soil exhalation rate. Perhaps the solution to the radon problem is to zone the land in uranium mining districts so as to forbid human habitation.[62]

Marline also fails to report that although the NRC has written regulations to require mill owners to clean up their wastes, current law bars the NRC from enforcing these regulations.[63] Nor is there any guarantee that the law as now written will be in force when Marline applies for a license. At that time, the law may be repealed, weakened, or not enforced.

Cleanup technology, in other words, is far from perfect. Current methods and materials may prove inadequate; they are vulnerable to accidents; and they may break down with time. And the current cleanup laws may nct be in force when Marline builds its mills.

Conclusion

Uranium mining and milling expose workers to significant amounts of radiation. Because of radon daughters in uranium mines, underground miners are five times as likely to die of lung cancer as non-miners. Even at levels of these gases now called "safe," miners still have a more than doubled risk of lung cancer.

Uranium mill tailings contain tons of radioactive wastes. Mills also discharge large amounts of acid, as well as other dangerous chemicals. Current methods cannot guarantee that these wastes will not pollute nearby land, rivers, and groundwater. At this time, tailings have seriously contaminated the land and water in many areas.

Uranium mining in Virginia will involve some very real risks to people. Some of those risks will continue for hundreds of thousands of years. Virginians need to get satisfactory answers to their questions and concerns before they allow uranium mines on their land.

For more information on uranium mining in Virginia, contact:

STOP Uranium Mining in Virginia
SR. #3 Box 380, Rochelle, VA 22738

The Piedmont Environmental Council
P.O. Box 460, Warrenton, VA 22186

Glossary

millirem (mrem): one thousandth of one rem. A background radiation level of 110 mrem is less than one-ninth of one rem.

rad: the amount of radioactive energy your body absorbs when it is exposed to radiation. One rad is 100 ergs (units of energy) absorbed by each gram of the body's substance.

rem: the dose of radiation your body absorbs, corrected for the type of radiation exposure. Different types of radiation (X-rays, beta rays, alpha rays, etc.) do different amounts of damage to your body. The rem measures, roughly, the amount of damaging radiation your body absorbs.

Uranium breaks down into radioactive chemicals called *radon daughters* that contaminate the air. When you breathe these chemicals, they irradiate the lungs. One rad of these substances in the lung does 10 to 20 rems of damage. One rad of X-rays, in contrast, does one rem of damage.

working level (WL):a measure of radiation energy in air (130,000 MeV of alpha radiation per liter of air). In uranium mines, the main source of this radiation is a decay product of uranium, radon daughters. Radon daughters enter the lung with the air you breathe and irradiate the lung.

Working Level Month (WLM): 170 hours of exposure to one working level (WL). Exactly how much damage a WLM does is not certain. Scientists estimate that one WLM equals 6 to 28 rems of radiation damage to the lungs. A study group of the National Institute of Occupational Safety and Health (NIOSH) estimates that one WLM equals at least 10 rems of lung damage.

Current standards allow uranium miners to breathe 4 WLM of radioactive particles each year. This amounts to around 40,000 mrem to the lungs — *360 times the natural background radiation.* Even using the higher estimates of around 420 mrem per year as the natural background radiation to the lung, the workers' exposure limit amounts to *95 times this level.*

[*Sources:* National Institute for Occupational Safety and Health (NIOSH), "The Risk of Lung Cancer Among Underground Miners." NIOSH, June 30, 1980, p. ii, 35; Rundo, J., "Radioactivity in Man: Levels, Effects, and Unknowns." *To Address a Proposed Federal Radiation Research Agenda.* Interagency Radiation Research Committee, March 1980, Vol. I, p. 226; Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR), "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation." National Academy of Sciences, Washington, D.C., 1980, p. 87 (Estimates one rad equals 10 rems.); International Commission on Radiological Protection (ICRP) Recommendations. ICPR Pub. #26, 1977. (Estimates one rad equals 20 rems.)]

Notes

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