

MINUTES OF THE MEETING OF THE NATURAL RESOURCES COMMITTEE
FEBRUARY 16, 1981

The House Natural Resources Committee convened in Room 104 of the Capitol Building on Monday, February 16, 1981, at 12:35 p.m. with CHAIRMAN DENNIS IVERSON presiding and eighteen members present.

CHAIRMAN IVERSON opened the hearing on HB 697.

HOUSE BILL 697 REP. KATHLEEN MCBRIDE, chief sponsor, presented the bill which would require a license to use a suction dredge in state waters. One advantage to the bill would be getting a handle on how many dredges there are and that the operators are using them properly. Users may not always be aware that a stream belongs to a landowner. These dredges can have an effect on fishing. The license will contain an identifying number, the intake hose diameter, date of expiration, and the location where use is allowed. There is no cost for the license.

Speaking as a proponent of the bill was REP. ORVAL ELLISON who said the Department of Health issued notices for hearings for dredge permits. He also felt that dredge operators should abide by the same laws as other people. Also felt regulations were needed as to what time of year the dredges may operate.

MAC JOHNSON suggested amending the bill by changing "complied with" to "be made aware of". He did support the bill.

BILL HAND, Montana Mining Association, supported the bill. He did mentioned that many of the suction dredges are strictly recreational used by amateur miners on occasion.

ROBERT VANDERVERE supported the bill.

RAY BECK, Montana Association of Conservation Districts, was in favor of the bill stating that there are many added problems due to the increased number of dredges. See Exhibit 1.

There were no OPPONENTS.

REP. MCBRIDE closed on the bill mentioning she did not favor the amendments suggested.

During questions from the committee, REP. SALES asked if this means that every time a miner moves the dredge, he needs a new permit. REP. MCBRIDE replied that you would need a new one each time or there is one that covers many locations.

REP. ROTH asked if there is a difference between a suction dredge and a regular dredge. REP. MCBRIDE said the main difference is that the suction dredge is very mobile.

REP. CURTISS asked under what conditions a permit would be denied. STEVE PILCHER, Chief of the Water Quality Bureau, replied there

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may be cases where there would be irreparable damage to the environment. In that type of case, the permit would be denied. REP. CURTISS then asked if there are any such cases now. MR. PILCHER said he did not know of any and that he could not generalize because each application is checked out individually.

REP. BURNETT asked MR. HAND how the mining industry would use this information to its advantage. MR. HAND replied that it would be good to know how many dredges are in the area.

REP. BURNETT then asked how much the program would cost. REP. MCBRIDE said there will not be a cost significant enough to justify having a fee. She stated further that enforcement would be more through a local sheriff.

The hearing on HB 697 closed and one on HB 652 opened.

HOUSE BILL 652 REP. TOM CONROY, chief sponsor, presented the bill which would remove the prohibition of disposal of certain radioactive materials enacted by Initiative 84. He felt this is a compromise bill relating to uranium mining in the state. He said he believed in nuclear energy and that we need the energy mining uranium can provide.

Speaking as a proponent was DR. S. L. GROFF, Montana State Geologist. See Exhibit 2.

REP. BOB MARKS, another sponsor of the bill, said it would provide an opportunity to develop nuclear mining operations and it would do so without endangering the people in Montana. Many people are fearful that the milling operations would leave a toxic waste dangerous to the public. This bill provides a reasonable control that we can live with. Developers would like to mine uranium if it is there. This would put money into the local economy and employ local people.

DENNIS LOPACH, representing the Montana Mining Association, gave a section by section analysis of the bill. See Exhibit 3. He said the U. S. Nuclear Regulatory Commission is responsible for uranium tailings in Montana. The act provides a vehicle for sampling of tailings of nuclear waste. The uranium producers are required to provide funds for reclamation. This bill follows the steps necessary to fully regulate the nuclear industry. Montana would license the activities at least as strictly as the federal government. The Health Department is designated as the licensing agent and the Air and Water Quality Bureaus would do their parts. He then produced some amendments to the bill (Exhibit 4) stating that the language in one of the amendments would restrict the prohibition deleted by I-84. He did not support that amendment, however, because he felt

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Montana must work with other states regarding the disposal problem.

MAXWELL K. BOTZ of Hydrometrics in Helena favored the bill. See Exhibit 5.

JAMIESON K. DEUL of Deul and Associates of Albuquerque gave a detailed overview of health effects from uranium tailings. See Exhibit 6.

WALT ACKERMAN, Administrator of Land Quality for the State of Wyoming, supported this bill. He said mining for uranium in his state was very profitable and that they were able to handle the industry without problems. He felt a state regulatory agency should be able to determine what happens. He further stated that his agency particularly checked on the ground-water problems.

STEPHEN GASH of Marathon Resources, Inc. supported the bill. See Exhibit 7.

HENRY E. REED of BurWest testified on behalf of the bill. See Exhibit 8.

DR. MICHAEL DONNELLY, Resource Associates of Alaska, Inc., spoke in favor. See Exhibit 9.

Other proponents were BILL STERNHAGEN, Northwest Mining Company; BILL HAND, Montana Mining Association; GARY LANGLEY, Western Environmental Trade Association; JANELLE FALLAN, Montana Chamber of Commerce; TERRY MCARDLE, Townsend Chamber of Commerce; JOE JEPSON, Economic Stabilization Corporation of Broadwater County (Exhibit 10); LARRY LLOYD, Department of Health and Environmental Sciences (Exhibit 11); GEORGE JOHNSTON, ASARCO; and, PHIL WALSH, Montana Council of Gem and Minerals.

Speaking as an opponent of HB 652 was DON SNOW, Director of the Montana Environmental Information Center. See Exhibit 12. MR. SNOW also provided the committee with some proposed amendments as shown in Exhibit 13.

JIM LYNCH gave some details of uranium mining in New Mexico. He then introduced two people who live in New Mexico. The first was WILLIAM PAUL ROBINSON of the Southwest Research and Information Center. He stated that 45 percent of all mined uranium has been mined in New Mexico. He felt the proponent testimony was an oversimplification of mining and milling of uranium. He wondered if anyone knows what the benefits are of agreement states in taking over from the federal government. Four out of five mines operating in New Mexico are doing so without proper licensing. There are no reclaimed mines in New

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Mexico. The same situation exists in Arizona. Arizona asked for the federal government to take back the licensing process, because the state could not afford to provide the licensing. Wyoming is a non-agreement state where the Nuclear Regulatory Commission provides the licensing. The federal government is not prepared to handle the groundwater problems. The benefits of agreement states are not clear. Initiative 84 provides for reasonable regulation of the industry. The initiative further asks for the best technology available. It is a mechanism for providing regulations. The costs of providing the regulatory licensing are very large and the legislature should be aware of that before getting into the processing. MR. ROBINSON used an overview which is attached as Exhibit 14.

BRENDA MCBRIDE, Grants, New Mexico, spoke as an opponent of the bill. She has lived her entire life in Grants which is billed as "the uranium capital of the world". The original promise from the mining industry was for jobs, good economy, and community development. Now the community is dealing with a boom/bust type of situation instead of a steady growth. In addition, the natural resource base is being depleted. The companies have a way of getting by the regulations. She felt people must be considered when starting this type of industry.

JAMES CONNER, Flathead Energy Council, was concerned with the bill because it attempts to overturn a voter initiative in addition to the problems that must be dealt with in nuclear mining. See Exhibit 15. He further stated that once the voters have spoken on an issue, the legislature should not tamper with it until it is proven wrong.

ED DOBSON, the author of Initiative 84, protested that this bill is not a compromise on I-84 because he had no part in the drafting of it. He further stated that in effect I-84 is being repealed by this bill and that the initiative did not ban uranium mining in the State of Montana.

MARK MACKIN, Citizen's Legislative Coalition, stated that it has been said the voters did not know what they were voting on. He maintained the voters did know and that they stated they did not want garbage dumped in their backyards, and, more especially, radioactive garbage. He further stated that HB 652 does not just amend I-84, it eliminates it.

ALAN OSTBY, Common Cause, opposed the bill.

MIKE MALES opposed the bill.

REP. CONROY closed on the bill.

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During questions from the committee, REP. HUENNEKENS asked if we are giving the federal government complete control of the process in the State of Montana. MR. LOPACH replied that the regulations affecting radioactive waste will be enforced by the state.

REP. HUENNEKENS then asked MS. MCBRIDE if the same bright promises were made by the mining industry in New Mexico. The answer was yes.

REP. NORDTVEDT asked MR. CONNER if he thought uranium mining should be banned in Montana. The answer was mining would not be banned but might be more expensive. MR. DOBSON stated that one thing not addressed by all of this was that uranium mines are closing around the country because the market is down.

REP. HUENNEKENS asked if the state could take over the regulations but not join with the agreement states. MR. LOPACH said that was the situation in Wyoming. The state regulates but with federal help. Without permission from the Nuclear Regulatory Commission, mining cannot begin.

REP. HARP asked MR. REED what his company's plans were for mining in Montana. He answered that the company had planned to spend about \$500,000 a year in Montana for exploration.

REP. NORDTVEDT asked MR. DEUL which forms of energy are the most safe. The answer was natural gas and nuclear.

REP. QUILICI asked if uranium mining comes under the same rules as other types of underground mining. The answer was yes.

REP. NEUMAN asked MR. REED what kind of uranium mining his company planned to use, open pit or underground. The answer was underground.

REP. ROTH asked MS. MCBRIDE if she favored banning uranium mining completely. The answer was yes.

REP. NEUMAN asked if the underground type of mining can be done without polluting the groundwater. The answer was yes.

REP. SHELDEN asked how long it takes to receive all of the proper permits before actual mining can begin. The answer was at least five years and probably ten before a company can start producing.

REP. QUILICI asked why the production of uranium is down. The answer was at least partly due to the incident at Three Mile Island.

REP. CURTISS asked what impact I-84 has had on other types of mining. MR. REED replied that it had some impact because when mining uranium

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the company sometimes runs across something else more valuable and then uranium becomes the secondary ore. Or, when mining something else such as copper, you could run across uranium and it could become the primary ore.

The hearing on HB 652 closed.

The meeting adjourned at 3:15 p.m.

Respectfully submitted,



DENNIS IVERSON, CHAIRMAN

Ellen Engstedt, Secretary

VISITORS' REGISTER

HOUSE NATURAL RESOURCES COMMITTEE

BILL HB 697

Date 2/16/81

SPONSOR MCBRIDE

IF YOU CARE TO WRITE COMMENTS, ASK SECRETARY FOR LONGER FORM.

PLEASE LEAVE PREPARED STATEMENT WITH SECRETARY.

VISITORS' REGISTER

HOUSE NATURAL RESOURCES COMMITTEEBILL HB 652Date 2/16/81SPONSOR CONROY

NAME	RESIDENCE	REPRESENTING	SUP- PORT	OP- POSE
Dennis Lopach	Helena	MT. Mining Assn	X	
Steve Smith	Denver, Co.	Marathon Resources	X	
Phil Walsh	Helena	MT. Mining Assn. Mt. Council Govt. Mineral Societies	X	
Merle Copenhagen	HELENA	MT. Mining. Assoc.	✓	
Henry E. Reed	Billings	BurWest	X	
Mike Donnelly	DENVER CO 10	RESOURCES ASSOCIATES	X	
Walt Ackerman	Cheyenne, Wyo	State/Wyo-DEO	X	
W.M. Bot	Helena	Self/Hydroelectric	X	
Bill Sterkogen	Helena	Northwest Mining Assn.	✓	
Bill Hand	Helena	MT. Mng. ASSOC.	✓	
Carole Brass	Butte	Citizens Leg. Coalition	✓	
Steve Whittier	Helena	IDES		
Alan Ostby	HELENA	Common Cause		✓
Mary Langay	HELENA	WETA		X
J. J. Stoff	Butte	State Geologist	X	
George R. Nichols	Helena	ASACO	X	
Quville Fallon	Helena	Mont. Chamber	X	
Teray McArile	Townsend	Chambers Com.	✓	
Joe Jepson	Townsend	Broadwater Co. STERKARAN Com.	✓	
Mike Males	HELENA	SELF		✓

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PLEASE LEAVE PREPARED STATEMENT WITH SECRETARY.

VISITORS' REGISTER

HOUSE NATURAL RESOURCES COMMITTEE

BILL HB 652Date 2/16/81SPONSOR CONROY

NAME	RESIDENCE	REPRESENTING	SUP- PORT	OP- POSE
Jeff Carlson	Helena	self	X	
Phil Walsh	Helena	self	X	
Lloyd Griggs	11	Anaconda/ Helena	X	
David Harris	Denver	Anaconda	X	
Peter Briggs	✓	✓	X	
PAUL ROBINSON	ALBUQUERQUE, NM	ON INVITATION OF CONCERNED CITS. FERTILE		X
James X Lynch	Talispell	CONCERNED CITIZENS FOR - 24	X	
Ed Dobson	Billings	self	X	
Maryann Ken	Helena		X	
MARK MACKIN	Helena	C.t. Leg. Coal.	X	
TERRY McNEIL	Townsend	C of C.	X	
Joe Jepson	Townsend	BROWNWATER CO. FC. STABILIZATION CO.	X	
LARRY Lloyd	Helena	Dept Health Env Sci	X	
Gloria A. Park	Helena	MT POWER TO THE PEOPLE	X	
John Conner	Kalispell	self	X	

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PLEASE LEAVE PREPARED STATEMENT WITH SECRETARY.

VISITORS' REGISTER

HOUSE

COMMITTEE

BILL 652

Date 2/16/81

SPONSOR

IF YOU CARE TO WRITE COMMENTS, ASK SECRETARY FOR LONGER FORM.

PLEASE LEAVE PREPARED STATEMENT WITH SECRETARY.

WITNESS STATEMENT

Name Ray Beck Date 2/16/81
Address 7 Edwards Support? X
Representing Mont Assn of Cons Dist Oppose? _____
Which Bill? HB 697 Amend? _____

Comments:

The Conservation Districts administer SB 310
(Natural Streambed and Land Preservation Act),
HB 697 would greatly assist the Conservation
Districts administer SB 310.

The Montana Assn of Conservation
Districts would like to be shown in
the record in support of HB 697

Please leave prepared statement with the committee secretary.

HOUSE BILL 652

STATEMENT:

Dr. S. L. Groff, Montana State Geologist

In my opinion Initiative 84 is vague and unclear in certain aspects -- which would result in multiple court actions, confusion, and adverse effects to any plans to produce uranium or thorium.

Reasonable and positive safeguards are necessary, but there is no reason not to produce nuclear fission fuel. Therefore, I recommend HB 652 as a rational substitute for I-84.

Montana is not considered to have a high uranium production potential as compared to Wyoming, Utah, Colorado, or New Mexico -- but Montana and Idaho share the probable largest deposit of thorium in North America.

I recommend favorable consideration and a "do pass" for HB 652.

HOUSE BILL NO. 652

Section by Section Analysis

Section 1. This amendment to the purpose section of Montana's radiation control explains the Legislature's intent to provide a regulatory program for the long-term control of tailings resulting from uranium and thorium ore processing.

Section 2. The modified definitions are needed to ensure conformity of Montana's statutes with the model state Uranium Mill Radiation Control Act developed by the staff of the U. S. Nuclear Regulatory Commission. With these amendments in place, Montana is free to pursue "agreement status" with the federal government under the federal Uranium Mill Tailings Radiation Control Act of 1978. Such status would allow Montana and not the U. S. to regulate mill tailings.

Section 3. The deletion of (3) eliminates language possibly in conflict with NRC regulations that might pose a barrier to agreement status.

Section 4. Amendment of (2)(c) clarifies the scope of the Department of Health's rulemaking powers.

Section 5. The addition of subsection (9) allows the Health Department to defray its costs through assessment of fees for the issuance of licenses and inspection of the operations of licensees.

Section 6. This new provision confers upon the Health Department the power to condemn title to disposal sites following expiration of a license issued by the Department for a disposal site. Title to the byproduct materials would also be condemned, but only if this transfer of ownership is required to protect the public's health, safety or welfare.

Section 7. This section requires that the Department develop standards for decontamination, decommissioning and reclamation of tailings sites. Licenses for activities that

produce byproduct materials must ensure that the Department's standards will be met before the license expires.

Section 8. If tailings and a disposal site are condemned, the Department must require a surety, or financial guarantee, from the licensee in sufficient amount to allow for full decontamination, reclamation, and, if necessary, long-term maintenance of the disposal site.

Section 9. The exemption discussed in this section applies only to activities conducted by agents of the federal government. The Department would monitor these activities inspite of the exemption.

Section 10. This provision precludes adoption by the Health Department of standards, licensing requirements or financial conditions more stringent or burdensome than the parallel requirements of the federal government.

Section 11. The policy section of Initiative 84 is amended to substitute a state regulatory program for the disposal ban.

Section 12. (1) of this section allows the disposal of radioactive waste in Montana if done pursuant to a license issued by the U. S. or the state. (2) is eliminated as unnecessary.

Section 13. This section amends the penalty provision for violations of the disposal statute to clarify that a violation occurs only if no license is issued covering the activity.

Section 14. This section provides that condemnation pursuant to the act is a public purpose for use of the eminent domain power.

HOUSE BILL NO. 652

1. Title, line 15
Following: "84"
Strike: "."
Insert: ";" AND PROVIDING AN IMMEDIATE EFFECTIVE DATE."

2. Page 15, line 14
Following: "dispose"
Strike: "in Montana"

3. Page 15, line 18
Insert: "(2) The disposal in Montana of large quantity radioactive material produced in other states is specifically prohibited, notwithstanding (1)."
Renumber: the following subsection

4. Page 19, line 25
Insert: "Section 18. Effective Date. This act is effective on passage and approval."
Renumber: the following sections

EXHIBIT 5

February 15, 1981

Representative Dennis Iverson
Chairman, House Natural Resources
Montana Legislative Assembly
State Capitol
Helena, Montana 59601

Representative Iverson:

My name is Maxwell K. Botz and I reside in Clancy, Montana. I am testifying as a proponent of House Bill 652. I am president of Hydrometrics which is a consulting firm in Helena, Montana. I am a registered professional engineer in Montana and have worked in Montana for over 15 years on mining and water resources problems. My previous experience includes 6 years as head of the Hydrology Division of the Montana Bureau of Mines and Geology and 4 years as chief of technical investigations section for the Montana Water Quality Bureau.

Initiative 84, approved by the general public in November, 1980, has raised a number of problems both in the mining industry and with engineers and environmental scientists in Montana. I have several concerns about Initiative 84 and its status as law in Montana.

My first concern with Initiative 84 is that the Initiative description in the state's voter information pamphlet was misleading in its description relative to uranium mining in Montana. Page 4 of this official publication stated:

"The proposal does not specifically prohibit the mining of minerals such as uranium..."

Initiative 84 does, in fact, prohibit mining of uranium in Montana as I am sure potential mining companies will testify in this hearing. In my opinion, the voters in Montana were not concerned about uranium mining, but were concerned about the so-called "dumping" of highly radioactive nuclear wastes in Montana. Such wastes could be hazardous to the environment in Montana.

Secondly, the passage of this Initiative stops all development of a potentially important sector on Montana's mining economy without benefit of meaningful public debate and, I believe, with minimal public understanding of the issues. I would ask the question. How many

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ordinary Montana citizens could read Initiative 84 and determine its impact? I submit that few citizens would have concluded Initiative 84 would prohibit uranium mining in Montana. I believe an amendment to allow uranium mining in Montana is entirely consistent with the public attitude and consistent with the citizen desire to protect Montana's environment.

Mining of uranium in Montana can occur by in-situ solution processes or as open pit mines and underground mines. There are existing state and federal laws and regulations that cover uranium mining and provide for protection of the environment. I would like to briefly describe the existing regulatory framework in Montana relative to potential uranium mining.

In-situ uranium mining consists of injection of chemical solutions through wells into the ore bearing zone. These solutions dissolve uranium minerals in the ground and the solutions then are withdrawn from the ore zone by recovery wells. This mining technique is widely used in the western United States for recovery of uranium. This type of mining is completely and comprehensively controlled by the Montana Water Quality Bureau rule entitled, "Montana In-Situ Mining of Uranium Control System (MIMUCS) Permit." This rule provides a very stringent control for in-situ uranium mining and provides complete protection for the environment during mining. In-situ mining also is regulated by the Montana Strip and Underground Mine Reclamation Act and regulations pursuant to this act.

Open pit mining and underground uranium mining is controlled under the Montana Department of State Lands Strip and Mining Reclamation Act and by regulations pursuant to this act. Montana rules passed pursuant to this act are in conformance with the U.S. Department of the Interior, Office of Surface Mining, Strip and Underground Mine Reclamation Rules. Montana mining rules are considered to be the most stringent in the United States. These rules cover every phase of underground and strip mining, including permitting, mine planning, reclamation, protection of the environment, protection of water and air quality, bonding and many other factors relative to protection of the environment.

Tailing from uranium mining operations have been of concern. In response to this concern, Congress, in November, 1978, enacted Public Law 95-604 entitled "The Uranium Mill Tailings Radiation and Control Act of 1978." Purpose of this act is to:

"...regulate mill tailings during uranium or thorium ore processing at active mill operations and after termination of such operations in order to stabilize the control of such tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public."

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After passage of this act, the U.S. Nuclear Regulatory Commission (NRC) produced a generic environmental impact statement on uranium milling dated September, 1980. Purpose of this EIS was to assess any potential environmental impacts of uranium milling operations and to provide an opportunity for public participation and decisions on proposed changes in the Nuclear Regulatory Commission regulations on uranium milling and tailings disposal.

The uranium milling generic EIS carefully and thoroughly examined the adequacy of existing regulations concerning mill tailings. This effort also recommended revisions of these regulations to assure public health, safety and protection of the environment. The U.S. Nuclear Regulatory Commission presently is developing comprehensive regulations for uranium mill tailings. These regulations presumably will be implemented by the NRC and potentially the regulatory program could be assumed by individual states as these states develop parallel regulations and demonstrate the capabilities for administering these rules.

In summary, the mining, milling and disposal of wastes from the uranium industry are covered by an existing comprehensive set of laws and rules. The Nuclear Regulatory Commission proposed rules on milling and disposal of wastes are specifically keyed to solving problems that have occurred in the past due to disposal of tailings.

I am particularly concerned about potential impacts of mining and milling on water quality. This is a sensitive issue in Montana and has been identified as a potential problem in uranium developments. I am very familiar with existing water regulations and have, in fact, written portions of these regulations. I am confident that existing Montana Water Quality Bureau regulations will prevent deterioration of groundwater from in-situ mining. These rules also will very adequately protect surface waters from uranium mining, milling and tailing storage operations. The Montana Department of State Lands regulations provide for protection of groundwater from strip and underground mining. This proposed bill also has provisions for development of regulations to protect water resources.

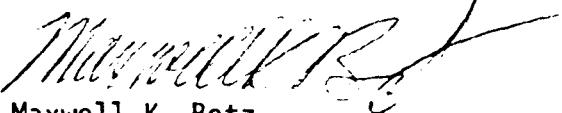
Banning of uranium mining in Montana by Initiative 84 appears to be a case of a significant regulatory constraint - in this case, a ban on mining - with little commensurate environmental benefit. It is my opinion that this is the type of regulatory control that is counter-productive and should be reconsidered by the Montana legislators.

A final concern about uranium mining in Montana is the ability of the state to adequately regulate this activity. I believe the state's stringent regulatory programs for air quality, water quality and coal mining clearly demonstrates Montana's capability for controlling development activities.

Representative Dennis Iverson
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For these reasons, I support the House Bill 652. Thank you for the opportunity to comment on this issue.

Sincerely,



Maxwell K. Botz
President

MKB:bb

HOUSE BILL NO. 652

Statement of Jamieson K. Deul

Concerning

Low Level Effects From Uranium Mill Tailings

My name is Jamieson K. Deul. I am a member of Deul and Associates of Albuquerque, New Mexico, specialists in environmental licensing and permit management. I have been asked by the Montana Mining Association to testify in support of House Bill No. 652 by offering some observations on health effects of uranium tailings.

My educational and professional background includes a broad range of experience relative to nuclear science. I am a graduate of the U.S. Naval Academy (1954), and a retired Commander from the nuclear submarine fleet. I have nine years of graduate nuclear engineering experience. Additionally, I hold an advanced degree in business (MBA - management).

From 1975 - 1977 I was Senior Engineer for Ranchers Exploration and Development Corporation. Deul and Associates was formed in 1977. In May, 1980, I was elected President of Environmental Reclamation Managers, Inc., a Colorado corporation specializing in uranium mill tailings disposal.

In recent years I have delivered numerous technical papers at professional meetings, and have appeared before Congressional committees as an expert witness on environmental matters.

I consider my technical specialties to be radiological health effects and water chemistry. My statement here today will concentrate on health effects of uranium mill tailings. I am pleased to have the opportunity to share these observations on this extremely important issue. My hope is that I can dispel certain common misconceptions about the health effects associated with uranium mining and milling.

The "Radon Connection"

For the purpose of this statement, I will concentrate on the ubiquitous radon gas as the principle, low level radiation effect from uranium tailings piles. Standards have also been proposed for gamma radiations but, by most accounts, this is much less of a low level problem than is radon. I am also aware of some recently completed research at Oak Ridge National Laboratories that suggests that Polonium may be a major concern in tailings, but that data is preliminary at this time.

What is radon gas? In the first place it is not a gas in the accepted sense; that is, it has no driving pressure head. It might prove a more convenient description to call it radon vapor. Radon vapor, then, is 7½ times heavier than air. Radiologically, it is an alpha emitter which means it spontaneously gives off high ionizing potential, but low penetrating power, particles. In fact, the alpha particle has such low penetrating power that this sheet of paper will

completely shield a person. The problem, though, is breathing radon decay products, called radon daughters. If radon daughter products are ingested into the lungs, their alpha emissions may cause cancer. The principle carcinoma associated with breathing radon, or more basically, associated with radiological effects, is oat cell carcinoma of the undifferentiated small cell type. Radon has a 3.8 day half life, which means in less than four days, half of its initial radioactivity has decayed away. In less than a month it essentially becomes inert or non-radioactive.

The Tailings Situation

The NRC, in its April, 1979, Generic Environmental Impact Statement (GEIS) on uranium milling estimates (p.3 - 17) that by the year 2000 we will have almost 2900×10^6 MT of radon emitting tailings in the U.S. However, since this estimate was developed, a significantly lower (by about 30%) national electrical demand is predicted and none of the new mills projected for start-up in 1980 are on-line as of the fall of that year. There are basically two categories, chronologically, of tailings--active and inactive. The later group are those WWII, Manhattan Project-related tails that have been abandoned following accepted procedures at the time. In 1978 the government adopted the legal position of "compassionate responsibility" for those 1940's crises generated wastes and passed the Uranium Mill Tailings Radiation Control

Act (UMTRCA). The Department of Energy has seven years, (after the new standards are established) and over \$500M to clean up 25 designated inactive sites across the country, most of which (22) are in the western states. The Environmental Protection Agency (EPA) is responsible for writing the cleanup standards for this program. In a Federal Register issue (April 22, 1980) when their interim standards were published the EPA stated:

"Tailings usually only pose a significant risk to people who are exposed for a long time."

and

"The greatest hazard from tailings on open lands is increased levels of radon decay products in buildings."

Tailings Reclamation Regulations

Last year an amount of soil cover that had grown from two feet in 1977 to seven feet in 1978, including a compacted two foot clay cap, to, finally, a minimum of three meters or about 10', was adopted by the NRC. At first the standard was designed to reduce the radon emission level to no more than twice background (and the gamma ray levels to equal background). The revised regulations proposed in the NRC's Generic Environmental Impact Statement, issued in September of 1980, specify an absolute amount of radioactive flux-- a measure of radioactivity per unit of area in a given time increment--without regard for how high or how low the natural background conditions actually are. The NRC proposes $2\text{pCi}/\text{m}^2\text{-sec.}$

Field Experience With Tailings Reclamation

To date there has been only one full scale test of a modern tailings reclamation action. My firm designed and executed the post-operation reclamation evaluation plan for this facility when it ceased operations. In a report to the responsible state regulatory agency (Duel & Associates letter of December 21, 1979, to Mr. C. Mattson, Colorado Department of Health) we provided the following results for a tightly engineered compacted clay cap of 2' - 3':

Background (17 stations, 43 measurements) -
 $2.45 \text{pCi/m}^2\text{-sec}$

Tailings site (8 stations, 24 measurements) -
 $1.81 \text{pCi/m}^2\text{-sec}$

When discussing these actual results with less than three feet of clay cover versus the requirement for 10' (3m), as now promulgated, regulatory officials tell me they are not surprised. Regulatory officials argue that the extra cover is needed to protect the site from erosion for 1,000 year time periods or longer. Although subject to a great deal of dispute, the 10' requirement prevails.

Linear Hypothesis

To discuss the low level health effects related to tailings one must keep in mind this assumption. It can best be described as saying if a lot of something is bad for you

then a little of it is also bad in a proportionate way. Until recently there was extensive data on radiological effects at high levels but an almost total void of information in the low level area. Most agencies responsible for radiological health have adopted the linear, no threshold hypothesis as a conservative way to proceed. However, some others feel that the body does have a tolerance level for radiation just like it does for aspirin. Below a certain level, aspirin can be very therapeutic; well above that level, it can cause serious physical effects. Those who challenge the linear hypothesis as being unrealistically restrictive point out cases like Denver which has about twice as much natural radiation (because of its altitude) as New Haven but also has a lower cancer incidence rate. Recently a small number of researchers have suggested that successively lower levels of radiation have greater and greater impacts on the individual. This would seem to suggest that the maximum impact would occur with no radiation present. The linear, no threshold hypothesis is a major bone of contention in many low level effects assessments.

Low Level Health Effects

- From Mining

I hope that most people would accept the assumption that uranium miners are, as a group, unavoidably at greater risk from low level (and high level) radiation effects than

the general public. After three years of searching through death records the Uranium Epidemiology Study of the UNM Cancer Research and Treatment Center in Albuquerque has found no cases of lung cancer deaths among New Mexico miners who started work in or after 1961. Their study group consists of almost 4,100 underground miners with one year, or more, experience. Although this study has many more years to run, this initial data is a dramatic early statistic. In Grand Junction, Colorado, widely known pathologist, Dr. Saccameno, has been following lung cancer deaths in the Colorado Plateau for over 25 years. The cases of oat cell carcinoma (radiation related) in 292 lung cancer deaths through 1979 have dropped steadily in every five year recording period measured. From 1954 - 1959, over 76% of miner lung cancer deaths were of the oat cell type. In his most recent 5-year period (1974 - 1979) that percentage has dropped to under 23%, close to the frequency of occurrence in the general public. In 1979 there were no oat cell carcinoma deaths.

- From Tailings

A world famous health physicist with extensive credentials in academia and major government agency contracting, Dr. Keith Schiager, testified (Albuquerque - October 18, 1979) against the NRC low level effects predicted in the GEIS. Their estimate of 10 deaths per year through the year 3,000 should only be "one-fourth of one premature cancer death per year"

and for completely uncovered tailings, far different from the 10' of cover now required. The "proposed radon emission criterion of $2\text{pCi}/\text{m}^2\text{-sec}$. is not based upon either the necessary protection of individuals or on considerations of public health risks", he pointed out. The GEIS assumed outdoor, background radon concentrations (not flux) in the west of $240\text{pCi}/\text{m}^3$. A 1969 government study by Shearer and Sill reports levels in Grand Junction (800), Durango (500), Salt Lake City (380) and Monticello (340) all above the NRC stated average. The use of averages instead of site specific conditions was decried. Schiager added that:

"No mining company would be in business if the only ore available contained the average mineral concentration found in the earth's crust."

Even for a worst case scenario of (1) a residence built directly on a reclaimed tailings pile with (2) a radon emission rate of at least 10 times the NRC limit it was shown that the indoor rate "would still fall within the range of natural background."

Risk Comparisons

At the same hearing in Albuquerque when Dr. Schiager testified in 1979, chemical engineering PHD, Dr. Harrison Rhodes, with the Union Carbide Corporation, presented an American Mining Congress (AMC) developed set of curves showing some comparative risks. (See Figure 1). Because of the

wide range of risks included it was necessary to represent them with a logarithmic vertical axis.

Consider first the risks taken directly from the draft GEIS. The far-field and continental risks shown in the bottom two curves are lower than those for the regional population by factors of about 200 and 250, respectively. On a far-field basis the risk from uncovered tailings is nearly an order of magnitude below the lower end of a suggested acceptable risk range of 0.1 to 1 health effects per million persons per year, and is about the same as an FDA recommendation of an acceptable level of risk for carcinogenic residues in meat products.

The draft GEIS risks are shown by the upper curve in the figure. At the base case level of no control (a flux of $450\text{pCi}/\text{m}^2\text{-sec}$) the risk is about 4. This is about 1/20 of the risk of natural background radiation, about 1/3 the risk of being in a room with a smoker or the risk from common household accidents. The $2\text{pCi}/\text{m}^2\text{-sec}$ requirement suggested by the GEIS is clearly not supported by the risks.

The Question in Perspective

The NRC, in an overly generous prediction, said in the GEIS that we would have $2900 \times 10^6\text{MT}$ of uranium mill tailings by the year 2,000. That huge sounding volume of tails would occupy only 0.0013% of the land mass of the contiguous 48 states. Whether you accept fully the arguments for the lack

of any real evidence for a proven low level radiation effects problem, surely the point is made that it will not have a major geographic impact on our nation. This should be more obvious when one considers the normal remote, semi-arid location of most uranium mills.

University of Pittsburgh physicist and researcher, Dr. Bernard Cohen has viewed the perspective in another way. He has taken the GEIS fatality predictions of 10/year (which Dr. Schiager says should be only $\frac{1}{2}$ person/year) and compared them, unadulterated, with other known risks. The GEIS mill tailings risks, using NRC's figures, equate to 4 fatalities per year with today's population. Compare this with:

All accidents	-	100,000 vs 4 !
Suicides	-	28,000 vs 4 !
Drownings	-	8,000 vs 4 !
Choking on food	-	3,000 vs 4 !

At this point I hope the Committee can properly evaluate the low level radiation effects from uranium mill tailings.

The Need for Uranium

Uranium has only one peaceful use--the generation of electricity. The petroleum fuels we are currently burning up at an alarming rate represent irreplaceable sources of key elements of pharmaceuticals, plastics, fertilizers and other important products. If we do not use our uranium resources they will gradually decay away. Our energy plight

is so severe that we must also use coal for the time being but it has a far greater impact on our environment than nuclear ever will have. If we are to survive and not use nuclear power, an alternative must be provided. None exists today or in the foreseeable future that will meet the expected demand. Solar, for the large central power generating requirements of schools, hospitals, theaters, etc., is still 20 - 50 years away. Geothermal, wind, ocean currents, and others can help but only for limited portions of our energy needs. Even assuming the more gradual energy growth curve of 1980, we still will face crippling shortages in a few years if we don't get going very soon. The United States needs nuclear power today.

Opposition to Uranium and Nuclear Power

I do not suggest that my statement represents the only viewpoint, the only perspective. I have tried to be as factual and straightforward as I can. Others will differ from my perspective, some for philosophical reasons, some for personal bias and even some for political considerations. What I hope can be avoided, however, is the phobia approach. Robert L. DuPont, a practicing psychiatrist and President of the non-profit Institute for Behavior and Health, describes it this way:

"A phobia is a malignant disease of 'what if's'. The phobic thinking process is a spiraling chain reaction, to use an atomic energy analogy, of

'what if's', and each 'what if' leads to another. 'What if this happens and then what if that happens, and then what if the other thing happens?' Phobic thinking always travels down the worst possible branching of each of the 'what if's' until the person is absolutely overwhelmed with the potentials for disaster."

I feel we must work very hard to avoid phobic thinking about uranium, and must arrive at a practical view of the need for this mineral. The other real dangers today are too great, far greater than the 'what if' potentials for health difficulties from uranium mining and milling.

Thank you for your time and consideration.

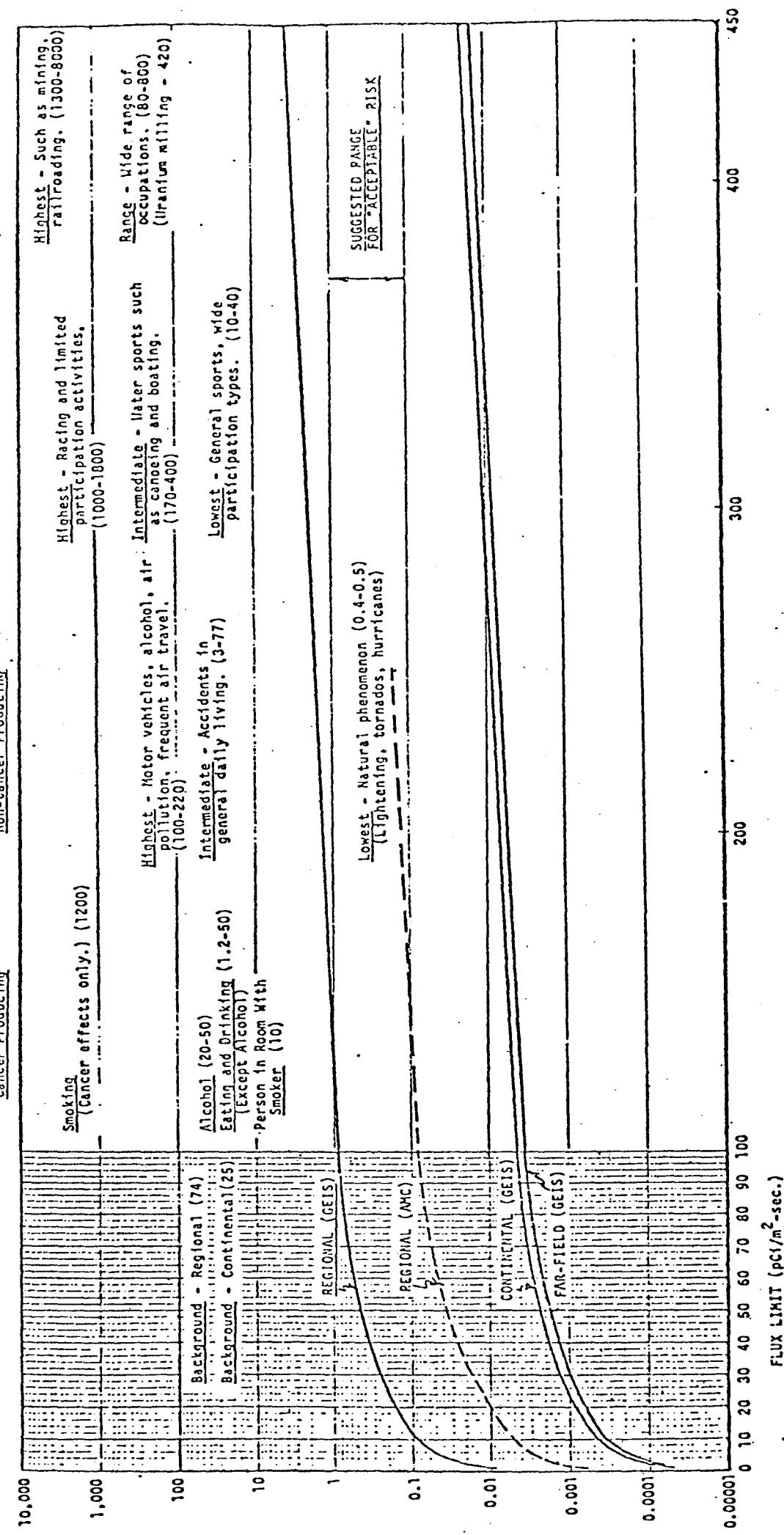
REGIONS AT RISK CONTINENTAL EXPOSURES
ACCUMULATIONAL AND DAILY DOSE

RANDOM EXPIRATION FROM TAILINGS

COMMONPLACE DAILY LIFE

SPORTS AND RECREATION

OCCUPATIONAL



TESTIMONY IN SUPPORT OF
HOUSE BILL NO. 652

Today, I would like to address the general economic benefits, environmental trade-offs, and national energy implications of the development of the uranium solution mine in Montana; and present a brief synopsis of the regulatory framework for a uranium development in Montana.

Virtually any such development would go through three phases: an exploration phase, a pilot testing phase, and a commercial phase. Exploration activities would result in several boosts to the local and regional economy. There would be payments to surface landowners for exploration and drilling privileges, contracts let with local exploration drillers, and local purchases of equipment and materials. The permanent and temporary employees on site during the drilling season would purchase goods and services from stores, motels, etc., as a result of the exploration activities.

During pilot testing, virtually all of the payments and purchases of goods and services mentioned for exploration would be expanded. A typical pilot operation might last one to two years and would have anywhere from 12 to 15 full-time employees.

In a commercial operation, all of the above types of payments would be increased proportionately according to the activities. Most significantly, the commercial facility would have a life expectancy of approximately 20 years and have a full-time staff of approximately 75 employees. These will be permanent, well-paying jobs in a developing industry. In addition, approximately 50 to 75 workers would be required to construct the facility. There has traditionally been a good transition of workers from construction to production. Approximately one-half to three-fourths of the workers at a typical production facility

can be from the local work force.

The base for county property taxes would be increased considerably, easing the burden on local landowners. In addition to the payroll and the local purchase of goods and services, such a facility would generate royalties to both the landowner and to the state under various provisions of existing state law. Significantly, it would contribute to long-term stability with good jobs as part of the local economy, and expand the financial base of banks for home loans and other services.

Let's turn for a minute to the environmental trade-offs involved in such a development. No one can responsibly state that there will be "no environmental impact" from any new development, be it housing, energy, mining, highway, or whatever. However, when you look at the comprehensive environmental review currently mandated by state and federal laws and regulations, a uranium solution mine stacks up pretty well against, say, a conventional uranium mine.

For a typical open-pit uranium mine and mill, the total disturbed area would be approximately 700 to 1,000 acres. By contrast, a solution mine would disturb about 100 to 200 acres during the life of the facility. Surface disturbance and excavation are vastly reduced, as is the extent of surface revegetation. The number of employees for a conventional facility would be 600 to 700. A commercial-sized solution mine typically has about 75 employees. Thus, the potential impacts to local social service delivery systems are reduced considerably. The unplanned "boom town" situations which have occurred at some western energy developments are not likely to occur with a solution mine.

The potential energy that can be produced from the products of the uranium mine are considerable compared to more conventional resources. When processed into a nuclear fuel, a pound of yellowcake provides the energy equivalent of

approximately 1700 gallons of oil or 10 tons of coal. This means a typical uranium solution mine facility designed for 250,000 pounds of yellowcake per year would produce the energy equivalent of over 770,000 barrels of oil, or 25 million tons of coal per year. This statement is not anti-coal or anti-oil; it is merely a fact. Nobody wants the western states to become energy colonies for the east, and I am not saying that we shouldn't mine coal. However, it appears inconsistent to me that those who oppose coal mining also would oppose a uranium solution mine which could produce a considerable amount of energy resources at a fraction of the impacts.

The developments which would be encouraged by the passage of this bill would provide good energy production for the impacts incurred. The affected area, both the land surface and the ground water, can be reclaimed and restored in compliance with all state and federal requirements.

In summary, the passage of this bill will mean more jobs for Montanans and more revenue to the state. If it doesn't pass, it will mean fewer jobs and less revenue for the state, and even greater dependence on foreign energy imports.

Stephen L. Gash
Marathon Resources, Inc.
Denver, Colorado

TESTIMONY TO NATURAL RESOURCES COMMITTEE

MONTANA HOUSE OF REPRESENTATIVES

HB 652 - February 16, 1981

I am Henry E. Reed of Billings, Montana. I am Director of BurWest, a joint venture of Burlington Northern and Westinghouse operating primarily in the states of Washington, Idaho and Montana for the purpose of finding and developing uranium deposits. BurWest has spent approximately \$5 million in exploration since 1975, over half of which has been in the state of Montana. During that time we have found important occurrences of uranium which deserve further exploration and evaluation to see if an ore deposit exists. During 1980, BurWest intended to spend about one half million dollars in exploration in Montana. In addition we had a potential joint venture with a third party which could have generated several hundred thousand additional dollars for exploration in Montana.

When Initiative 84 qualified for the ballot, BurWest pulled out of Montana, abandoned its projects and did only clean-up work. We suspended work in the Townsend area where a drilling contract had been issued. Following the apparent defeat of Initiative 84, we returned to the Townsend area and began drilling, only to have the official canvass reverse the verdict, whereupon we abandoned the project.

As a result of the passage of Initiative 84, BurWest and, as far as we know, all other uranium exploration companies, have suspended or abandoned their exploration and development for uranium in Montana. Because of this Initiative, BurWest has less funding than previously and has terminated two employees. Both of these employees are graduates of the University of Montana; one has a family and home in Missoula. Both are among the ranks of the unemployed. We have also cut back on the administration staff. Thousands of dollars which could have been paid to landowners in the State of Montana for royalties will be lost if Initiative 84 is not reversed.

Proponents of Initiative 84 convinced enough people that uranium mining would not be banned to result in its passage. I personally direct a uranium exploration and development firm and I can tell you that Initiative 84 does effectively ban mining of uranium in Montana. Proponents of the Bill point out that we could move the tailings or the ore body out of state. We often hear about one company which moves ore from Colorado to New Mexico; however I have a letter here from that company, Homestake Mining, pointing out that it is a temporary movement for them to try to get some cash flow. They are leaving a mountain of low grade ore that will ultimately be processed by a mine-site mill, and as they point out, it is environmentally unsound to continue such a movement because of the energy waste to move the ore by truck (letter attached). It would be like telling the coal industry that they can mine coal by surface methods but will have to move the overburden to another state. It might be physically possible, but it would be economically and environmentally ridiculous.

BurWest is interested in continuing exploration in Montana to find and develop uranium resources vital to national defense and our energy and medical industries. In doing so, we will provide opportunities for jobs, lease and royalty income to landowners, including the State of Montana, and an increased local and state tax base.

HOMESTAKE MINING COMPANY

PITCH OPERATIONS

320 NO. MAIN

GUNNISON, COLORADO 81230

COAL & MINERALS
BILLINGS

JUN 2 '80

TELEPHONE 303 641-3295

May 30, 1980

RLB REH
PCC CWJ
MGC HER
FILE

Mr. H. E. Reed, Assistant Vice President
Coal and Minerals Division, Burlington Northern
800 First Northwestern Bank Center
175 North 27th Street
Billings, Montana 59101

Dear Mr. Reed:

Earlier this month you spoke with the Environmental Coordinator for Homestake Mining Company's Pitch Mine. The conversation revolved around the proposed Montana Initiative 84 and the effect it would have on uranium mining. Homestake's Environmental Coordinator had been mis-quoted in a local paper as saying that it was profitable for Homestake to ship uranium ore from Colorado to mills in New Mexico. Most of the inaccuracies in this statement were verbally explained to you; however, I would like to take this opportunity to provide a written reply.

Homestake Mining Company has not yet obtained the necessary license for the construction of a mill at our mine site in Western Colorado. We anticipate being able to begin construction by late this fall. Until that time, however, we will continue to ship ore to mills in northern New Mexico.

Several aspects of this operation should be noted: an important fact is that we are shipping only high-grade ore, and lower-grade ore is being stockpiled at the mine in anticipation of the mill development. Without the development of the mill, the Pitch Mine would run out of shippable high-grade ore within several years.

More importantly, shipping ore to New Mexico for milling is not a profitable operation for Homestake Mining Company--it is being done for two reasons. First, although shipping uranium ore is not profitable, it does generate a cash flow for continued mine operations and mill development. Secondly, Homestake does have uranium delivery commitments and at present this is one of the ways those commitments are met. Shipping ore will be discontinued as soon as the mill at the mine site is operable.

Mr. H. E. Reed
May 30, 1980
Page 2

For Homestake Mining Company to ship all of its uranium ore to out-of-state mills would be unreasonable. It would be unreasonable not only from the perspective of company economics but also from the perspective of a logical national energy policy. Such an operation would not only be non-profitable for Homestake but, as you point out, also a terrible waste of energy.

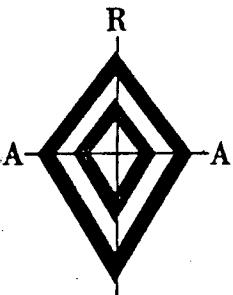
We felt that perhaps a written reply would be helpful to you. If you would like further clarification or additional information, please feel free to contact us.

Sincerely,



Joe Danni
Public Relations Manager

JLD:nea



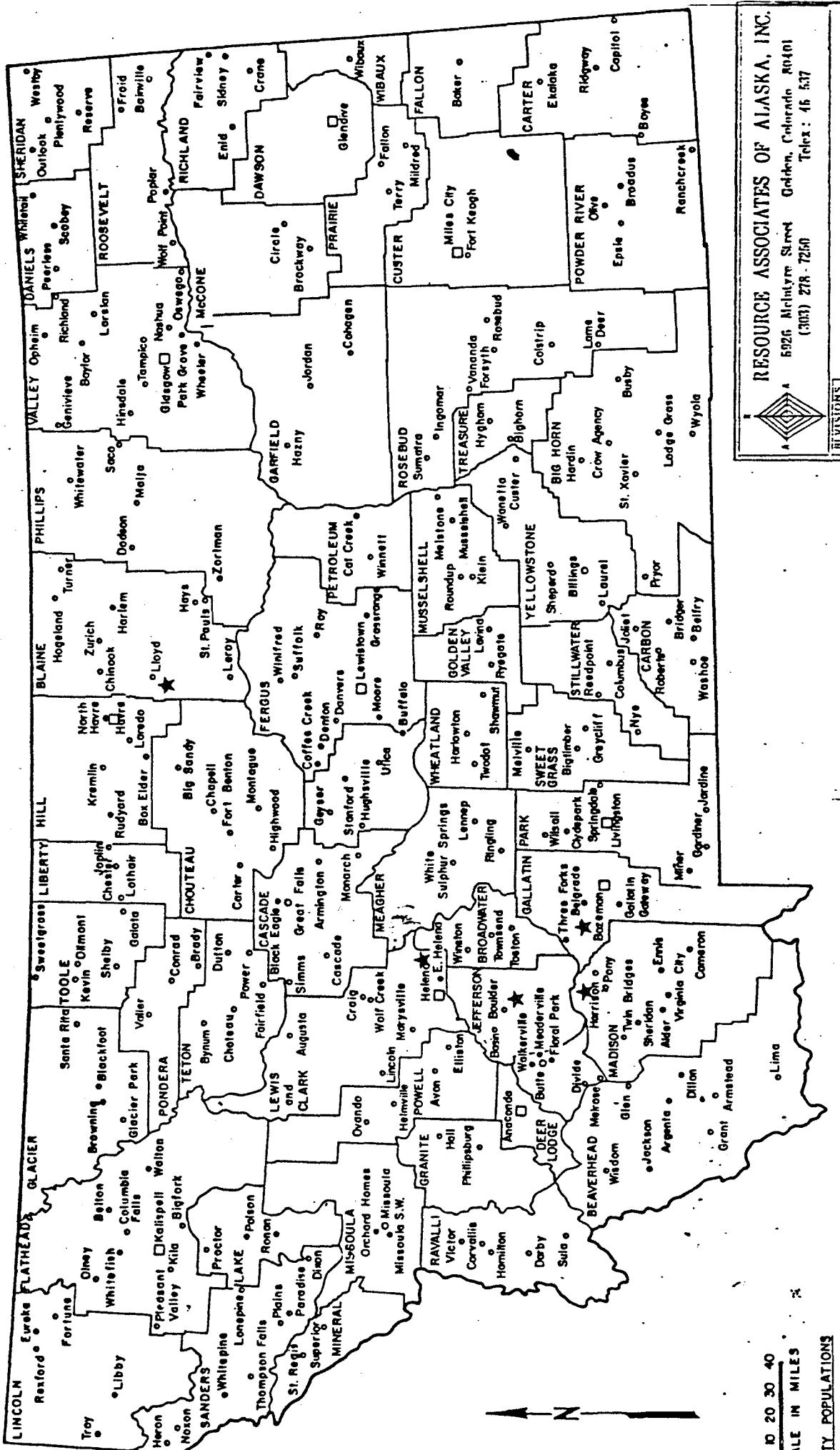
RESOURCE ASSOCIATES OF ALASKA, INC.

5926 MCINTYRE STREET, GOLDEN, COLORADO 80401
TELEPHONE: (303) 278-7250
TELEX: 45 537

TESTIMONY IN SUPPORT OF HOUSE BILL 652
PERTAINING TO DISPOSAL OF RADIOACTIVE WASTES
STATE OF MONTANA HOUSE COMMITTEE ON NATURAL RESOURCES

Dr. Michael F. Donnelly
Vice President
Resource Associates of Alaska, Inc.
5926 McIntyre Street
Golden, Colorado 80401

February 16, 1981



0 10 20 30 40
SCALE IN MILES
CITY POPULATIONS

- o 25,000 to 100,000
- 10,000 to 25,000
- 1,000 to 5,000
- under 1,000

RESOURCES OF ALASKA, INC.
6226 McKinley Street, Anchorage, Alaska 99501
(363) 278-7251
Tele: 46-5317

IN MONTANA

Resource Associates of Alaska's uranium exploration program in the western U.S. includes a major commitment in Montana, because of the State's high geologic favorability to host major new deposits of uranium. Some of these new deposits may also be accompanied by economic amounts of strategic and precious metals that are critical to the national defense and economy.

RAA holds five uranium properties in Montana (Figure 1). These are held through combinations of private leases with Montana residents, Montana State leases, and federal lode claims.

In addition to the five properties, RAA has identified fourteen areas, primarily in western Montana, that have high potential for economic deposits of uranium and other metals. These additional areas will be considered for further evaluation and possible minerals rights acquisition, provided the negative aspects of I-84 are modified by passage of House Bill 652 or some equivalent measure.

Further investment in acquisitions of mineral rights or reconnaissance exploration will depend largely upon the emergence of a State policy that allows for the reasonable and safe disposal within the State of radioactive waste products of uranium mining and milling, or of production of other metals associated with uranium. The necessity to dispose of such wastes outside the State would preclude, in nearly all cases likely to occur in Montana, the economic recovery of a uranium or associated metals ore body.

Table 1 summarizes the economic benefits of RAA's exploration program to the State of Montana, Montana residents, and businesses. Terms of RAA's leases include royalties, bonus payments, and annual rental payments. Therefore, if an economic deposit of uranium or associated metal is found, the lessor (State of Montana or private landowner) could realize a substantial income in the form of royalties, in addition to the annual lease and advanced royalty payments.

For example, \$15 million in royalty payments would be received by the State of Montana, in addition to any applicable taxes, if an economically exploitable uranium deposit were discovered on State leased land, assuming minimum parameters for such a deposit, under conditions likely to prevail during the next five to ten years.

RAA's exploration program in Montana was sharply curtailed in June, 1980, when Initiative 84 appeared to have qualified for inclusion on the November ballot, because its inclusion rendered uncertain the entire future of a uranium-mining industry in the State. Exploration projects in Montana budgeted at \$920,000 were cancelled for 1980. All drilling was stopped. Reconnaissance programs were replaced with work in other states that had sound regulatory systems (either the NRC or their own) for disposal of radioactive wastes associated with the production and processing of uranium ore.

All mineral rights acquisition was stopped, including acquisition of State leases, leasing from private landowners, and claim staking. Therefore, even before its passage, I-84 substantially diminished the abilities of landowners, including the State, to realize an economic gain by leasing mineral rights for exploration and to have their land evaluated by drilling. In addition, the Initiative also impaired RAA's ability to exercise its rights to evaluate and

develop federal claims under U.S. mining laws.

Exploration of RAA's properties during 1980 was confined to the minimum necessary to hold the properties, including the federal assessment obligations, until the outcome of the radioactive waste disposal issue could be determined.

After the Initiative passed, a major effort on RAA's part to joint venture the Montana properties was interrupted because of the uncertainties about the future of uranium mining in Montana among as many as eleven major exploration companies that had, prior to the Initiative, showed strong interest in the properties. As a result, the expenditure of \$7 million planned under these joint ventures in Montana was not realized. In addition, internal work plans for properties, which planned for the expenditure of between \$1.7 and \$3.0 million in drilling and mineral rights acquisition during 1981, were not implemented.

Unless disposal of uranium mining, milling, and other processing wastes is allowed in Montana, RAA will probably curtail any further exploration in the State. This will apply to other metals in addition to uranium, because of the likelihood in Montana that any economic metal deposit discovered, particularly strategic and precious metals, would be associated with anomalous concentrations of uranium, and thus could be economically unrecoverable under Initiative 84. Our exploration funds will be re-directed into states where their expenditure has a chance of being recovered by future production of a discovered deposit.

Passage of Bill 652 or its equivalent will allow continuation of RAA's reconnaissance programs, of property drilling programs, of lease payments and royalty provisions, of additional mineral rights acquisition, of joint venture development, and of deposits of State reclamation and performance bonds.

Exploration companies such as RAA require the assurance of a long-term, reasonable economic and political climate to justify the many years and large expenditures within the State that are required to locate new ore deposits. If State policies do not provide such assurance, funds will be directed elsewhere. And once halted, such exploration programs are commonly more expensive to start up again, thus becoming even more risky and difficult to justify economically.

If Bill 652 or its equivalent is passed and our program in Montana continues, RAA believes that any new resources that are discovered can be developed within the State responsibly under existing federal licensing procedures, or under a future state regulatory system similarly structured to protect public health and the environment. The new resources will result in substantial economic benefits for the State of Montana, its residents, and the U.S. as a whole.

TABLE 1

ECONOMIC FACTORS OF RAA'S URANIUM EXPLORATION PROGRAM IN MONTANA

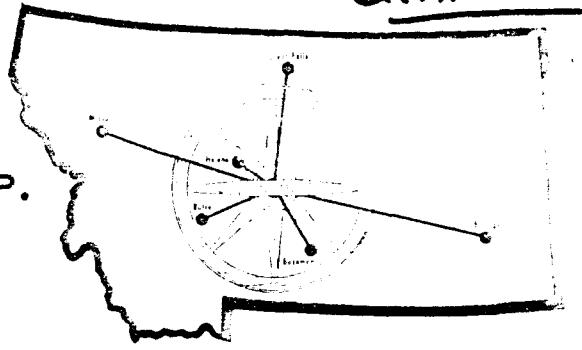
1.	LEASES OF MINERAL RIGHTS, TOTAL ANNUAL RENTAL.	• • • • •	\$ 64,000
State of Montana:	10,300 acres, 27 leases, \$10,300 annual rental		
Private Landowners:	12,000 acres, 20 leases, 53,700 annual rental		
TOTAL		<u>\$64,000</u>	
2.	FEDERAL CLAIMS, TOTAL ANNUAL COST TO FULFILL STATUTORY ASSESSMENT.	• • • • •	\$ 105,000
	420 claims x \$100/claim x 2.5 ² = \$105,000		
3.	BONDS PAID IN 1980 TO STATE OF MONTANA	• • • • •	\$ 68,000
	Reclamation Bonds \$43,000		
	Performance Bonds 25,000		
	TOTAL	<u>\$68,000</u>	
4.	TOTAL SUNK COSTS OF EXPLORATION IN MONTANA THROUGH JANUARY, 1981	• • • • •	\$2,000,000
5.	FUNDS PREVIOUSLY PLANNED FOR EXPENDITURE ON MONTANA PROGRAM IN 1981 (ACTUAL EXPENDITURE DEPENDS UPON RESULTS OF RADIOACTIVE WASTE DISPOSAL LEGISLATION)	• • • • •	• • • \$1,987,300-\$3,222,300
	Annual Payments of State and Private Leases	\$ 64,000	
	Federal Claim Assessment Work	105,000	
	Bonds Paid to State of Montana	88,300	
	Drilling	\$1,310,000-\$2,645,000	
	Acquisition of Additional Mineral Rights	420,000	
	TOTAL	<u>\$1,987,300-\$3,222,300</u>	

¹State lease payments accelerate in 1982.

²Factor used to establish total cost of work done to fulfill the statutory assessment obligation of \$100/claim.

ECONOMIC STABILIZATION CORP.

P. O. BOX 96 • TOWNSEND, MONTANA 59644



Montana State Legislature
Montana State Capitol Building
Helena, MT 59601

RE: HB652

Dear Sirs:

I am representing the Economic Stabilization Corporation of Broadwater County. My group would like to see a workable solution found to the problems caused by Initiative 84.

Broadwater County has not only lost a projected \$250,000 in uranium exploration but also the financial benefit that would occur if exploration for the ore were successful.

Broadwater County has lost this potential benefit in the name of "preservation of our environment". My group feels that the environment is adequately protected by the State Department of Health and the Environmental Protection Agency without doing away with the beneficial effects of uranium mining.

For these reasons, the Economic Development Corporation of Broadwater County supports House Bill 652.

Sincerely,



Joe Z. Jepson

Department of Health and Environmental Sciences

Testimony to the House of Representatives, Natural Resources Committee,
Regarding House Bill No. 652

Prepared by Larry Lloyd
Occupational Health Bureau
449-3671

The Atomic Energy Act of 1954 was amended on November 8, 1978, by the Uranium Mill Tailings Radiation Control Act (UMTRCA). Prior to the enactment of UMTRCA uranium mill tailings were not within the definition of source material or any other material licensable by the U. S. Nuclear Regulatory Commission (NRC). Therefore, prior to UMTRCA uranium mill tailings were beyond the NRC's licensing jurisdiction and were subject to control by state governments.

The definition of "Byproduct Material" was redefined in UMTRCA to include uranium and thorium mill tailings, thus encompassing uranium and thorium mill tailings under the licensing jurisdiction of the Nuclear Regulatory Commission.

Montana's 1967 Radiation Control Act contains legislation enabling the Governor to negotiate with the NRC to assume the licensing and regulatory authority currently exercised by the NRC in Montana. This "Agreement Status" has never been negotiated.

Presently the NRC licenses and regulates Byproduct Material (reactor-produced radionuclides, and effective November 8, 1981, uranium and thorium mill tailings), source material, and special nuclear material. Montana's current laws and regulations would enable the Governor to begin negotiations for state assumption of licensing and regulatory authority for Byproduct Materials with the exception of uranium and thorium mill tailings. Federal law requires that states wishing to regulate uranium and thorium milling and concentrating operations have certain authority to condemn and take possession

of lands upon which radioactive wastes have been disposed upon decommissioning of the disposal operation, to assume custody of wastes which have been disposed on these lands, and to impose surety requirements to ensure the completion of all decontamination, decommissioning, and reclamation of sites, structures, and equipment used in conjunction with generation or disposal of Byproduct Material. These surety requirements are also to provide for long-term monitoring or maintenance of the land or Byproduct Material if necessary.

House Bill No. 652, if enacted, will provide necessary state authority such that the Governor, if he should so elect, can initiate negotiations with the NRC to assume state licensing and regulatory authority over uranium and thorium milling and concentration operations.

TESTIMONY OF ENVIRONMENTAL INFORMATION CENTER IN OPPOSITION TO HB 652
TO: House Natural Resources Committee, 16 Feb. 1981

Environmental Information Center opposes HB 652 because this bill effectively repeals an initiative approved by Montana voters at the last election, because it sets up an unworkable and costly regulatory framework, and because it subjugates Montana's right to establish our own regulations to federal dictates.

HB 652 directly overturns the decision made by Montana voters to approve Initiative 84 in the November general election. We oppose on principal legislative repeal of an initiative measure. If the supporters of HB 652 are going to argue that Montana voters did not intend to "ban uranium mining" when they passed Initiative 84, then there should be no objection on their part to the legislature's calling a referendum on any legislative alternative to Initiative 84. We intend to offer a referendum clause amendment to HB 652.

If the legislature is going to offer HB 652 as an alternative to what the voters have enacted, there are a number of flaws in the bill we believe should be cleaned up. HB 652 establishes a cumbersome, unworkable, and expensive regulatory framework with no assurances of benefit to the state.

First, HB 652 is naive because it presumes without evidence that Montana is prepared to do all of the things required by the federal Uranium Mill Tailings Act of an agreement state. The federal Generic Environmental Impact Statement on Uranium Milling describes a number of requirements for agreement state status (enumerated). The personnel and funding estimated for compliance with these requirements are clearly inadequate to the task.

Second, we believe Montana will not be able to afford agreement state status, given what the federal N.R.C. requires. The fiscal note attached to this bill is hopelessly inadequate to determine the full costs of this measure to the state, but it does give some guidance: (1) the state will expend over \$80,000 just to consummate agreement status, (2) the state will lose an additional \$20,000 in each licensing proceeding, and (3) now the bad news: the fiscal note shows the N.R.C.'s estimate that licensing and inspection fees cover only 12% of the program costs required by this bill. That means the full program costs over \$550,000 per licensee, and the state loses nearly half a million dollars on each license. We have no idea what these losses will total because we cannot control the number of licenses issued. Even under optimistic assumptions, HB 652 sets up a very expensive regulatory program.

Third, HB 652 explicitly, in section 10, limits Montana to federal regulations and standards, leaving our regulatory policy to the dictates of Washington, D.C. Section 10 should be amended out of the bill, because the federal government specifically allows states to adopt more stringent regulations.

We offer these amendments to HB 652 for the purpose of cleaning up this bill to

the point where it can serve as a referendum. As written, HB 652 in no way protects Montana's interests, and even with these amendments it would be a risky assumption to rely on this legislation. Our amendments fall into ~~three~~ ^{three} categories:

(1) An amendment to require that licensees pay the full costs of the licensing and inspection program performed by the Department, not just 12%.

(2) An amendment to substitute the words "cash bonding" for "surety" wherever that word occurs. Because we are talking about activities to be performed over a very long period of time, many decades in some cases, and because surety is vulnerable to a number of failures, cash bonding in advance will better serve to protect state tax-payers against unanticipated future costs resulting from uranium milling.

(3) An amendment to set the types of activities to be bonded, the escalation rate to be used for inflation, and a contingency allowance, all to protect state taxpayers

from the kinds of large and long-term costs which have resulted from such activities in other states.

(4) An amendment to delete section 10 and substitute a statement that this act applies only to licensees to whom state regulations apply. If any state requirement is pre-empted by federal requirements, the amendment states that this act will become null and void with respect to that requirement and the provisions of existing law shall apply.

(5) A referendum clause to submit the legislative alternative to Initiative 84 to the voters of Montana at the November 1982 general election.

These amendments will not make HB 652 a good piece of legislation. E.I.C. prefers the existing law as passed by Montana voters, but we will accede to any decision made by the voters on this bill. We recommend a "do not pass" on HB 652.

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Notwithstanding this arrangement, one area where there were differences between NRC and State programs was that involving environmental reviews of proposed licensing actions. In response to this situation, NRC conducted a policy evaluation aimed specifically at the matter of environmental reviews in Agreement States. This policy review included a workshop sponsored by NRC in November 1977,¹⁰ to discuss primarily the matter of environmental reviews, to compare State practices with NRC practices and to assess the attitudes of the States regarding NRC reassertion of regulatory authority over uranium mills.

The NRC conducts an environmental review, in connection with each proposed major uranium mill licensing action, culminating in the preparation of an environmental statement that is circulated for public review and comment. Although the Agreement States were conducting environmental reviews of proposed mill licensing actions, preparation of an independent, documented environmental report was generally not a part of their regulatory programs. Although the States generally viewed such environmental reviews as beneficial, they indicated at the Workshop¹⁰ that extensive studies were beyond their financial or manpower resources and might unduly delay the licensing process. With respect to NRC's reassertion of regulatory authority over uranium mills, all Agreement States at the November 1977 Workshop indicated that they emphatically wished to retain licensing authority and vigorously opposed the idea of giving it up.¹⁰

The Commission concluded, in light of this information, and its own experience in licensing mills, that the licensing process in Agreement States would benefit from preparation of an independent environmental assessment similar to that conducted by NRC in non-Agreement States. In a policy statement⁵ the Commission indicated that such an assessment need not be identical in scope to those prepared for mills licensed by NRC; however, the assessment should treat the most important environmental aspects of milling operations: tailings waste management and disposal, siting, and radiological assessment.

Therefore, as part of its comprehensive program to strengthen public health and safety regulation of uranium mills, the Commission decided to offer technical assistance to Agreement States, on a temporary, trial basis, to assist them in assessing the environmental impacts of their uranium mill licensing.⁵ Under this arrangement, the Commission is in the process of assisting the States of Colorado, New Mexico, and Washington in the preparation of environmental assessments associated with several recent uranium mill licensing actions. As previously indicated, this technical assistance program is an interim measure to aid the Agreement States in upgrading their regulatory programs. This program is in the process of being phased out and will be discontinued when the new requirements for Agreement State licensing become fully effective in 1981. NRC staff is preparing revised criteria to be used in evaluating the effectiveness of Agreement State programs at the time of the amended agreement review in November 1981 (when the new requirements become fully effective) and in all subsequent reviews.

13.3.2 Legislation

The matter of Agreement State regulatory programs discussed below is now covered by the UMTRCA³ which specifies that when States license an activity involving mill tailings, that has a significant impact on the human environment, they must prepare a written independent analysis of the impact of such license on the environment, including any activities conducted pursuant thereto. This analysis, which must be available to the public before any licensing action is taken, shall include --

- "(i) an assessment of the radiological and nonradiological impacts to the public health of the activities to be conducted pursuant to such license;
- "(ii) an assessment of any impact on any waterway and groundwater resulting from such activities;
- "(iii) consideration of alternatives, including alternative sites and engineering methods, to the activities to be conducted pursuant to such license; and
- "(iv) consideration of the long-term impacts, including decommissioning, decontamination, and reclamation impacts, associated with activities to be conducted pursuant to such license, including the management of any byproduct material" (Section 204).³

Beyond this, the UMTRCA provides that the States are required to regulate tailings in accord with standards that are, to the extent practicable, equivalent or more stringent than standards promulgated by the Commission and the Administrator of the Environmental Protection Agency (Section 204).³ Thus, the Act represents a departure from the preexisting Agreement State requirements that Agreement State regulatory programs must be "compatible" with those of NRC. The new legislation demonstrates that on such a matter of national importance as mill tailings waste disposal (that involves long-term and potentially widespread environmental impacts), the Congress has concluded that a uniform national approach to solving the tailings waste disposal problem is warranted.

PROPOSED AMENDMENTS TO HB 652

Page 11, lines 12-14: delete: all of lines 12-14, from "consistent" to "licensees".
add, at end of line 13: a period after "specific licenses"

add, beginning with line 14: "The fees charged by the department for its radiation control services, program and inspection of licenses, and licensing shall be in an amount which will cover all of the department's costs for such services, program and inspection, and licensing. A general fund appropriation made to fund any program established by (this act) shall be reimbursed in full by the department out of fees paid to the department by licensees and others to whom the department provides services."

Page 13, line 5: delete: "Surety"
add, after "Section 8.": "Cash bonding"

Page 13, line 10: delete "surety"
add: "cash bonding"

Page 13, line 19: delete entire line
add: "department shall require the licensee to make available to the department in the form of a cash bond all of the funds"

Page 13, line 22: add, after "commission": "and the department"

Page 13, line 25: add, after "section": "shall be in the form of a cash bond and"

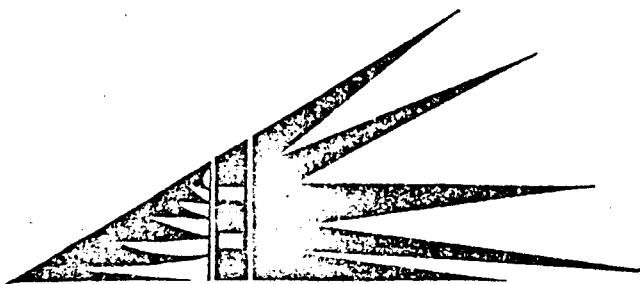
Page 14, line 1: add, after "for": "all decontamination, decommissioning, reclamation, and"

Page 14, line 2: delete after "and": ", if necessary," and "but do not"

Page 14, lines 3, 4, and 5: delete all of lines 3, 4, and 5

Page 14, line 5, add: "In determining the cash bonding requirements for each licensee, the department shall require cash bonding for all of the costs, as estimated by the department, for:

(a) the decontamination, decommissioning, and reclamation of ^{all} sites, structures, and equipment, including but not limited to the stabilization of and prevention of radio-



SOUTHWEST RESEARCH AND INFORMATION CENTER

RESPONSIBLE URANIUM MINING AND
MILLING: AN OVERVIEW

PRESENTED AT
FIRST INTERNATIONAL CONFERENCE
ON
URANIUM MINE WASTE DISPOSAL

VANCOUVER BRITISH COLUMBIA, CANADA

MAY 19, 20, 21, 1980

by

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My name is Wm. Paul Robinson. I have a degree in Human Ecology from Washington University in St. Louis and have done graduate work in environmental engineering at Johns Hopkins University and environmental design at University of New Mexico. I teach environmental impact assessment at the University of New Mexico in Albuquerque, New Mexico. I was asked to give this presentation only four days ago and will prepare a written summary of my oral presentation at the Conference for inclusion in the proceedings.

I would like to first summarize the relevant health information relating to the workers and general populations around uranium mining as a basis for understanding the hazards associated with these operations and their available remedies. This discussion will summarize the literature on Radon and its daughters, among the most toxic uranium decay products. Second, I will discuss waste handling in the uranium industry: past, present and future, discussing exploration, mining, and milling and the volumes of water and solid and gaseous wastes which are associated with these various phases of uranium operations. This paper will also include a discussion of the various past and present materials handling technologies and their responsiveness to the concern for uranium waste isolation. I will then conclude with a summary of recent modifications in the relevant standards as applied to uranium mining and milling.

Joseph Wagoner, a research epidemiologist with the U.S. Public Health Service and the Conference's original speaker for this time slot, has summarized the literature on uranium mining and its health effects in his written testimony as a commissioned witness in British Columbia Royal Commission of Inquiry into Uranium Mining in January of 1980, entitled Uranium, The U.S. Experience: A Lesson in History.¹ Briefly summarizing his report, as early as 1546, miners of uranium bearing ores in Central Europe were reported to have unusually high frequencies of fatal lung disease². As early as 1879, the real nature of pulmonary disorders among these miners was first diagnosed to be malignant neoplasia or lung cancers.³ Of 655 miners dying between 1875 and 1912, 40% or 276 of these Central Europe miners died of lung cancer.⁴ By 1939, it was reported that lung cancer mortality rate for miners in these Central European mining districts was several times (9.7 per 1000) higher than that for similar populations in Vienna, Austria (0.34 per 1000). Thus, before uranium mining began in the U.S., there was a considerable body of information linking uranium mining to lung cancers.

The U.S. experience can be summarized in Table 1 also from Wagoner's B.C. Testimony.⁵ This table shows that through 1978, 205 respiratory cancer deaths have been observed among white underground uranium miners in the U.S., for only 40 were expected. This is an increased relative risk of a factor of 5 and an attributable risk of 164 excess deaths. The epidemiological work summarized in Table 1 not only shows excess lung cancers but also shows a high relative frequency of small cell undifferentiated cell type cancers, (Table 2) and an exposure response relationship between radon daughter exposure and lung cancer incidence exclusive of cigarette smoking (Table 3).

Other studies, specifically Wagoner et.al, 1974,⁶ have tested the hypothesis by extending the lung cancer risk by identifying lung cancer risk among Native American uranium miners through 1973-74. (See Table 4). These studies demonstrated a statistically significant excess of respiratory cancer deaths, 11 deaths observed versus 2.6 expected. Of these 11 deaths, 8 were of the small cell undifferentiated cell type, and only 1 of these 11 Indian miners smoked more than a half a pack of cigarettes a day. A comparison has been made between the mean induction latent period for the various populations. The

mean induction latent period for white uranium miners with lung cancers who smoked at least one pack of cigarettes a day was 13.7 years; for Indian miners who smoked slightly it was 17.1 years, and for non-smoking Indian miners the latent period was 20.5 years.

Archer et.al., reported that in contrast to the experience of general populations, cessation of cigarette smoking did little to decrease the respiratory cancer risk among uranium miners. Other non-neoplastic or non-cancerous health effects among uranium miners have been identified by several workers. Archer et.al.⁸ concluded that, Wagoner says, "chronic exposure to air-borne radiation as encountered in uranium mines promoted pulmonary emphysema, vibrosis, and chronic bronchitis, all which may contribute to pulmonary disability." Karojovic et.al. demonstrated similar medical findings among radon-exposed miners in Yugoslavia, that is, disorders of the upper respiratory passage, bronchitis with emphysema and pneumoconiosis.⁹ By 1976, Archer et.al. had demonstrated that deaths due to non-malignant respiratory disease among U.S. radon-exposed uranium miners had reached epidemic proportions. Eighty such deaths were observed as contrasted with only 24.9 expected¹⁰ (See Table 5). Further, this exposure response relationship existed within each smoking category, i.e. non-smokers and smokers of less than or more than 1 pack of cigarettes a day.¹¹ Thus, we have a considerable body of information which identifies the health risks associated with exposures to uranium and uranium daughters.

Within this health record we also must have an understanding of the relevant uranium daughter levels in mines and surrounding areas. By the early 50s, the initial studies of U.S. miners had begun to generate an interest among the Public Health community leading to the first standards for radon levels in mines. By 1971, the United States Mine Safety & Health Administration (MSHA) had standards to reduce the level of radon and its daughters in mines to 4 working level months per year (1 working level equalling 1.3×10^5 Mev. of alpha radiation energy from radon daughters per liter of air or about 100 μCi of radon per liter of air, and 1 working level month equals 1 working level $\times 173$ hours for a working month.)¹²

Though these reductions began to occur in the '50s, the attainment of the radon standards has been questioned. Where some forms of mechanical ventilation were installed, it was found on occasion either to be so slight that it did not exceed natural draft induced air flow or non-functional due to inoperative blowers.¹³ In 1962, 68% of uranium mines in the Colorado Plateau still exceeded the then 1 working level standard and 4% were in excess of 10 times the recommended radon daughter exposure.¹⁴ By 1966, only 44% of U.S. underground mines had reduced radon levels to less than 1 working level¹⁵

As late as 1968 only 69% of underground uranium mines had controlled radon daughters to less than 1 working level¹⁶ Most recently the Mine Safety and Health Administration (MSHA) had indicated that levels which they found workers to be exposed to in mines were 5 times those reported by uranium operators.¹⁷ Current standards allow a maximum annual exposure to workers of 4 working level months or .3 working level months per working month.

This discussion has summarized the literature on radon daughters, the most studied toxic material associated with uranium mining and milling. Other materials of concern are found in liquid and solid wastes produced by the uranium

operations including thorium-230 and radium-226 and a range of non-radioactive heavy metals associated with the uranium ore deposits including arsenic, zinc, molybdenum and selenium.

To date, there are no reclaimed uranium mines in the U.S., Canada or other major uranium mining districts. Similarly, there are no reclaimed uranium mill tailings piles. Thus, though we can talk about a range of modifications in waste handling technology, we have no examples of the toxic materials in these wastes being isolated from populations. This goal of isolation of toxic materials is being pursued in most uranium mining districts. See, for example, the Uranium Mill Tailings Radiation Control Act (UMTRCA) in the United States, the Cluff Lake Inquiry concerning Saskatchewan, Canada, the Ranger Inquiry concerning the Northern Territory in Australia.

With respect to the phases of mining, concern necessarily focuses on exploration sites, the mines and the mills. Exploration work typically involves drilling. This drilling can result in contamination of groundwater supplies as a result of inter-aquifer communication. This inter-aquifer communication is the result of poorly plugged or unplugged holes providing conduits for groundwater movement between water supplies. Such impacts have been noted in British Columbia, New Mexico, and Wyoming. Exploration also results in surface impacts, such as increased erosion and reduced vegetation, at the drill site if no reclamation is accomplished.¹⁸ Both these groundwater and surface impacts potentially occur whether the ore found is economic to develop or not.

In uranium mining districts such as Wyoming and New Mexico in the United States and Australia, ores are found in saturated zones where the mines must be dewatered before resource extraction. This dewatering results in groundwater quantity impacts and groundwater quality impacts. While effluents can be treated to reach appropriate standards, the quantity impacts are typically much longer term and of a more serious nature in these mining districts. Most uranium mined comes from arid areas and accentuates this water quantity impacts. Also, the radon (see above) which must be reduced to protect miners is vented, without filters or high stacks, into the general air supply. This results in a high radon release into the general environment. Calculations by NRC staff indicate this release is approximately 4,000 curies of radon per annual reactor year (assuming 250 tons of yellowcake[refined uranium] per reactor year)¹⁹ In a 1979 overview of the New Mexico uranium industry, Betty Perkins estimated there were over 100,000 curies of radon released per year from uranium mining only in New Mexico.²⁰

This radon emission dwarfs any other routine releases from uranium fuel cycle.

With respect to the milling, the primary concern is with handling of liquid and solid tailings. These concerns are exposure routes to eliminate seepage, runoff, moving liquids offsite, windblown dispersion and impoundment structure failure. Initially, tailings were simply piled behind the mill and not managed in any way to specifically limit their off-site movement.²¹ The tailings were not widely well-recognized as a hazard through 1966 when incidents of tailings being used off-site and high rate on-levels occurred in thousands of homes and over a dozen schools in Mesa County, Colorado, U.S.A., and other areas.²²

This massive off-site use occurred even though the U.S. AEC (Atomic Energy Commission) was aware as early as 1961 of the possible health hazards from the use of mill tailings in construction of houses.

The public was not excluded from access to tailings piles until 1969. The remedial action in Grand Junction is costing approximately \$15,000 per home and over 355 homes have been reworked to remove tailings from their foundation.²³ Recently, several thousand more homes in which tailings have been identified were recognized through a tailings neighborhood survey conducted by the Environmental Protection Agency in 1973.²⁴

The tailings management procedures of companies have ranged from simply piling tailings out behind the mill as originally done to very elaborate burial of tailings in lined pits below the original surface. The range included a period when good tailings technology was considered to include above grade mill tailing impounded behind dams. A recent failure of such a dam at United Nuclear Churchrock dam in New Mexico has demonstrated the shortcomings of this technology and as a result new mills are not conventionally using this impoundment technology.²⁵ The current design solution for tailings isolation is below grade disposal in excavated trenches or existing mine pits and shafts.²⁶ With well-designed below grade disposal programs, there are fewer operational and long-term release possibilities; and this is the major difference between the two technologies given comparable geological sitings.

The most recent changes in the uranium licensing framework in the United States represent areas of intense interest by operators and communities. The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) allocates resources to reclaim inactive uranium milling areas. This law requires the Environmental Protection Agency to set standards, the Nuclear Regulatory Commission (NRC) to enforce standards, and the Department of Energy (DOE) to conduct the construction work in accordance with those standards. The standards for off-site clean-up criteria are .015 working levels of radon daughters in the air inside homes, and 5 picocuries per gram of radium-226 in soils.²⁷ This .015 working levels or approximately 1.5 picocuries per liter radon has been set based on an increased risk to lung cancer of 1% to a population exposed to 1 picocurie per liter radon;²⁸ thus, there is approximately 1.5% or 1500 per 100,000 increased risk associated with exposure to the new level. This exposure is set as a total radon release rather than an elevation and enhanced with above background, and interim final rules subject to modification after the adoption of the Final Environmental Impact Statement in the summer or fall of 1980. In addition, the Nuclear Regulatory Commission in the U.S. is modifying its 10 C.F.R. Part 20, Numerical Standards for Radioactive Materials Emission. The discussion of this revision can be found in the 45 Federal Register 56, Thursday, March 20, 1980, pg. 18025. These standards are being modified to include considerations for special provisions limiting exposures of susceptible groups (including fetuses, women in general, fertile women, and miners), control for moonlighters, contract workers, transient workers, a showing that persons occupationally exposed to radiation are well-informed of potential risks. This revision identifies the basic assumptions of radiation protection as: (1) there is within the range of exposure conditions, usually encountered in radiation work, a linear relationship without threshold between dose and probability of stochastic effect; and (2) the severity of each type of stochastic effect is independent of dose. This change in the 10 C.F.R. Part 20 standard will represent a major change in the radiation protection philosophy of the United States.

In addition to the Uranium Mill Tailings Radiation Control Act, control on tailings and their ultimate burial and public ownership, the Oil Chemical Atomic Workers Union and others have recently sued the Mine Safety and Health Administration to reduce the radon levels in mines.²⁹ The proposed reduction is from 4 working level months per year to .07 working level months per year and a maximum exposure in the mine of .01 working levels compared to an average exposure presently of .3 working levels. This petition to change the miner exposures is based on the work by Wagoner and others summarized in the initial part of this paper.

This presentation has briefly summarized the literature on radon daughter induced health effects among uranium miners, facility management problems and solutions, and recent modifications in the U.S. uranium regulatory framework. Persons interested in more detailed information regarding the information in this paper, please contact the author at Southwest Research and Information Center, P.O. Box 4524, Albuquerque, New Mexico 87106, (505) 242-4766.

END NOTES.

1. Wagoner, J.K. Uranium: The United States Experience: A Lesson in History, before the B.C. Commission of Inquiry into Uranium Mining, Vancouver, BC, Canada, January 1980.
2. Agricola, A.C. 1957. De Re Metallica. Basel. Cited by Hueper, 1942, and as translated by Hoover, H.C., and Hoover, L.C. Dover Publications, New York, 1950.
3. Harting, F.H. and Hesse, W. 1879. Der Lungenkrebs, die Bergkrankheit in den Schneeberger Gruben. Viertelj. f. gerichtl. Med. u. offen. Sanitäts. 30: 296-308. Ibid. 31: 102-132 and 313-337.
4. Arnstein, A. 1913. Sozialhygienische Untersuchungen über die Bergleute in den Schneeberger Kobalt-Gruben, insbesondere über das Vorkommen des sogenannten "Schneeberger Lungenkrebses" Österreich Sanitätswesen. Wien Arbeit., a.d. Geb. I. Soz. Med. Beihefte. 5:64-83.
5. See Reference 1
6. Wagoner, J.K., Archer, V.E., Gillam, J.D. 1975. Mortality of American Indian uranium miners. Proceedings XI International Cancer Congress. (Bucalossi, P., Veronesi, U. and Cascinelli, N., Eds.). Vol. 3., pp. 102-107, Excerpta Medica International Congress Services No. 351. Excerpta Medica, Amsterdam.
7. See Reference 1.
8. Archer, V.E., Brinton, H.P., and Wagoner, J.K. 1964. Pulmonary function of uranium miners. Health Phys. 10: 1183-1194.
9. Karajovic, D., Panov, D., Kilibarda, M., Medjedovic, M., Savic, S., Jovanovic, M., Cvetkovic, D., and Dodic, S. 1964. Analyse de l'état de santé des ouvriers de la mine d'uranium en Yougoslavie. Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. II: 385-397.
10. Archer, V.E., Gillam, J.D., and Wagoner, J.K. 1976. Respiratory disease mortality among uranium miners. N.Y. Acad. Sci. 271: 280-293.
11. See Reference 10.
12. From United States Code of Federal Regulations, 30 CFR 57.5-38 and 30 CFR 57.5-39.
13. Bates, R.C. and Rock, R.L., 1962. Estimating Daily Exposure of Underground Uranium Miners to Airborne Radon-daughter Products. U.S. Bureau of Mines Report RI 6106.

14. Holaday, D.A. and Doyle, H.N. 1964. Environmental studies in the uranium mines. Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. 1: 9-20.
15. Federal Radiation Council. 1967. Report No. 8 Revised. Guidance for the Control of Radiation Hazards in Uranium Mining. U.S. Government Printing Office. Washington, D.C.
16. Lundin, F.E., Wagoner, J.K., and Archer, V.E. 1976. Radon Daughter Exposure and Respiratory Cancer Quantitative and Temporal Aspects. NIOSH and NIEHS Joint Monograph No. 1. National Technical Information Service. Springfield, VA.
17. Mine Regulation and Productivity Report. Volume 2 Number 43, McGraw Hill, NY., NY., November 17, 1978.
18. Robinson, W.P., 'Field Survey of Sarah McCray's Allotment #871, which is under Navajo Lease N00-C-14-20-4938 on February 28, 1979.' Memo to DNA Legal Services March 5, 1980, Available at Southwest Research and Information Center, P.O. Box 4524, Albuquerque, New Mexico 87106.
19. Betty L. Perkins, An Overview of the New Mexico Uranium Industry, N.M. Energy and Minerals Dept., Santa Fe, N.M., January 1979, pp. 3-11.
20. See Reference 19.
21. Union of Concerned Scientists, The Nuclear Fuel Cycle, MIT Press, Cambridge, Mass. 1975, p. 41-70.
22. See Reference 21.
23. See Reference 21.
24. Lucius Pitkin, Inc., "Off-site Inventory of Uranium Tailings", USEPA, Washington, D.C., 1972.
25. Mill Tailings Dam Break at Churchrock, New Mexico, Hearings before Subcommittee on Energy and Environment, Committee on Interior and Insular Affairs, U.S. House of Representatives, U.S. Congress, Washington, D.C., October 22, 1979, Serial No. 96-25.
26. See Bokum-Marquez Uranium Mill License Application and Gulf-Mt. Taylor Uranium Mill License Application in New Mexico Environmental Improvement Division files, Santa Fe, N.M., USA, and "Review of Uranium Mill Tailings Management Programs involving Below Grade Disposal", Ross Scarano, USNRC, in the proceedings of this Conference.
27. USEPA, "Draft Environmental Statement for Remedial Action Standards for Inactive Uranium Processing Sites", Office of Radiation Programs, U.S. EPA, Washington, D.C.

28. See Reference 27 and Wagoner, J.K., "Uranium Mining and Milling: The Human Costs" written text of Presentation at University of New Mexico Medical School, Albuquerque, N.M. on March 10, 1980. Available at Southwest Research and Information Center, P.O. Box 4524, Albuquerque, New Mexico 87106.
29. Oil Chemical and Atomic Workers and Health Research Group, "Petition Requesting an Emergency Temporary Mandatory Standard for Radon Daughter Exposure in Underground Mines Under the Authority of the Mine Safety and Health Act.", Before the Mine Safety and Health Administration, United States Department of Labor, April 21, 1980.

TABLE 1

RESPIRATORY CANCER MORTALITY AMONG WHITE UNDERGROUND URANIUM MINERS

Period of Follow-Up	Obs.	Exp.	Relative Risk	Attributable Risk	Author
1950 - Dec. 1962	12	2.8	429	9.2	Wagoner, 1964
1950 - Dec. 1963	22	5.7	386	16.3	Wagoner, 1965
1950 - June 1965	37	7.4	500	29.6	Lundin, 1967
1950 - Sept. 1967	62	10.0	620	52.0	Lundin, 1969
1950 - Sept. 1968	70	11.7	598	58.3	Lundin, 1971
1950 - Sept. 1974	144	29.8	483	114.2	Archer, 1976
1950 - Dec. 1978	(205)	(40.0)	(510)	(164.0)	Wagoner, 1979

() = Estimates based upon incomplete follow-up.

From: Wagoner, J. K. Statement before Senate Special Committee on Aging.
Grants, New Mexico, August 30, 1979.

TABLE 2

Relative Distribution of Histologic Types of Excess (Presumably Radiation-Induced) Bronchogenic Cancers

Radiation exposure groups (WLM)	Epidermoid (1A + 1B + 1C) Excess Percent	Small cell undifferentiated (2A + 2B) Excess Percent		Adenocarcinoma (3A + 3B + 3C) Excess Percent		Other types (4 + 5 + misc.) Excess Percent		Total Percent Excess	10.79* 32.39*
		Excess	Percent	Excess	Percent	Excess	Percent		
1-359	0.94	8.7	8.27*	76.6	1.31	12.2	0.27	2.5	10.79*
360-1799	10.11	31.2	22.07*	68.1	0.13	0.4	0.08	0.3	32.39*
≥ 1800	10.68	21.5	33.69*	67.7	4.70*	9.4	0.68	1.4	49.75*
Combined groups	21.73	23.4	64.03*	68.9	6.14*	6.6	1.03	1.1	92.93*

* The observed numbers represented by these excess numbers are significantly different from the corresponding expected numbers ($p < 0.01$).

From: Archer, V.E., G. Saccoccanno, & J. H. Jones. Frequency Of Different Histologic Types Of Bronchogenic Carcinoma As Related To Radiation Exposure. Cancer. 1974.

TABLE 3

OBSERVED NUMBER OF LUNG CANCER DEATHS, TOTAL RATES AND ESTIMATED RATES FOR NON-SMOKING NON-MINING, SMOKING AND MINING EFFECTS BY CIGARETTE SMOKING CLASSIFICATION, OCTOBER 1960 THROUGH SEPTEMBER 1968

Cigarette Smoking Classification	Number of Lung Cancer Deaths	Rates per 10,000 person-years			
		Observed	Estimated Components		
			Non-Smoking	Non-Mining*	Excess Over Expected***
Non-Smokers	2	6.5	1.7	0	4.8
Former Smokers	5	42.1	1.9	0.7	39.5
Smokers of ≤ 1 Pack Daily	38	41.0	1.3	5.7	34.0
Smokers of > 1 Pack Daily	17	51.2	1.1	26.6	23.4
Total	62	36.7	1.4	8.4	27.0

*Based on non-smoking rates specific for age and calendar year.

**Based on indirect standardization for age and calendar year minus non-smoking rates.

***Based on excess of observed rates over expected rates standardized for age and calendar year.

From: Lundin, F. E., Archer, V. E., and Wagoner, J. K. An exposure-time-response model for lung cancer mortality in uranium miners-effects of radiation exposure, age and cigarette smoking. Energy and Health (Breslow, N. E. and Whittemore, A. S., Eds.). Society for Industrial and Applied Mathematics, Phil., Pa., 243-264. 1979.

TABLE 4

Expected And Observed Deaths By Cause Among Indian
Underground Uranium Miners, January 1960 Through December 1973.

Cause of Death	Expected	Observed
Tuberculosis, all forms	3.67	8
Malignant neoplasms , all	9.89	17
Digestive systsm	3.83	4
Respiratory system	2.58	11+
Other & Unspecified sites	3.48	2
Cardiovascular renal disease	25.34	3+
Violent deaths	41.38	44
All other known causes	43.52	28
Unknown causes**	<u>0.00</u>	<u>7</u>
Total	123.80	107

** Decedents for whom death certificates were not obtained.

+ Significant at 1% level.

From: Archer, V. E., Gillam, J. D., and Wagoner, J. K. Respiratory disease mortality among uranium miners. N.Y. Acad. Sci. 271: 280-293. 1976.

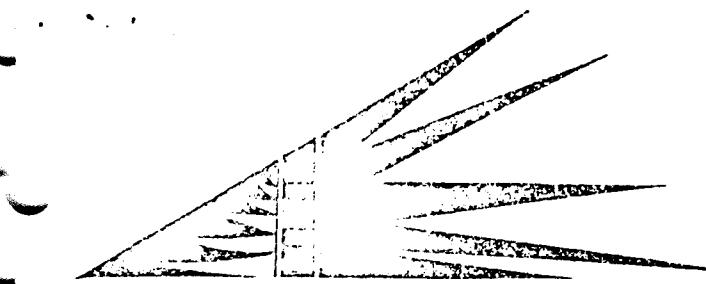
TABLE 5

OBSERVED AND EXPECTED NONMALIGNANT RESPIRATORY DISEASE
DEATHS ACCORDING TO TIME SINCE ONSET OF URANIUM MINING

AMONG WHITE UNDERGROUND MINERS: JULY 1950-SEPTEMBER 1974

CAUSE OF DEATH	YEAR SINCE ONSET OF UNDERGROUND URANIUM MINING					
	< 5	5-9	10-24.9	≥ 25	Total	
Nonmalignant respiratory disease	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.
ICD470-527	1	1.5	7	3.5	54	15.0
					18	4.8
					80	24.9

From: Archer, V. E., Gillam, J. D., and Wagoner, J. K. Respiratory disease mortality among uranium miners.
N. Y. Acad. Sci. 271: 280-293. 1976.



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RESUME: WM. PAUL ROBINSON

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Resume as of: July, 1980

EDUCATION:

-M. Arch. (all but Thesis)

-Presently enrolled in University of New Mexico, School of Architecture and Planning, Master of Architecture Program, emphasis in Environmental Design. (Coursework emphasizes analysis of natural and modified water systems including irrigation diversions, natural systems and urban flash flood channels and geology.)

Graduate Work:

-Environmental Engineering - Johns Hopkins University, 1975
(Coursework included water pollution chemistry and water resource engineering.)

B.A. :

-Anthropology, Washington University, 1974.
(Coursework included geology, technology assessment and ecology.)

EXPERIENCE:

August, 1976 - Present:

-Environmental Analyst, Southwest Research and Information Center. Work involves technical investigations of the use of natural, human and community resources in New Mexico. This includes:

-Environmental Impact Analysis;

-Water, land and resource use, assessment and planning;
Testimony before decision-making bodies on Federal, State and local levels;

-Working with community groups providing technical support on air, land and water issues;

-Technical research for Center legal proceedings;

-Applications of alternative energy solutions to urban and rural living situations;

-Sediment transport and trace element dispersion analysis;

-Groundwater and surface water discharge and withdrawal monitoring;

-Technology assessment studies of mining developments;

-Workshops on groundwater impacts, uranium industry growth and waste water management, mining regulations.

-Consultant, on water resource quality and quantity for DNA Legal Services, Zuni Legal Services, and Acoma Pueblo, Americans for Indian Opportunity, Northern New Mexico Legal Services, Sandoval Environmental Action Community, Albuquerque District Attorney's Office, Natural Resources Defense Council and Twinings New Mexico Sanitation District, and Minnesota Interim Legislative Committee on Uranium Exploration.

-Instructor, in Environmental Impact Analysis and Rural Environmental Planning, University of New Mexico.

January - May, 1977:

-Independent research at Technology Applications Center, University of New Mexico.

February, 1975 - June, 1976:

-Associate Project Engineer, ECOSystems International, Inc.:
ECOSystems provides consultant services to NASA, the United Nations and other clients.
Responsibilities include:
-Photo interpretation and land use mapping from color infrared aerial photograph and LANDSAT imagery;
-Detailed mapping of agricultural land use in U.S. and foreign countries;
-Delineation of Flood Plain topography from aerial photography and LANDSAT imagery and analysis of flood-plain characteristics;
-Analysis of problems and future of septic systems in Anne Arundel County, Maryland;
-Projections of population growth trends into environmentally sensitive regions and their effect in terms of sewage load;
-Statistical analysis of rainfall frequency and duration and streamflow variation to generate watershed models for computers;
-Development of national flood frequency schema;
-Correlation and compilation of crop spectral for use in analysis of ERTS data for crop forecasting and planning;
-Generation and mapping of detailed crop phenologies for U.S. and World;
-Correlation of water, nutrients, temperature and physiological factors into a general characterization of crop growth cycle;
-Evaluation of physiometric change in crops for normal and multi-characteristically stressed environments;
-Quantification of the effect of flooding on human and environmental systems for major world river basins;
-Compilation and production of papers, presentations.

1974 - 1975:

-Design Draftsman, Intech Corporation, Charlotte, NC. Work involved development of specifications and preparations of working drawings for machinery components.

1973 - 1974:

-Anthropological Researcher, Washington University. Data processing and compilation on the following projects:

-"Nutrition and Food Consumption in a Rural South Indian Community":

-"Comparison of Housing, Agricultural, and General Settlement Planning and Implementation of the Volta Dam, Ghana, and Kariba Dam, Zambia."

REPORTS AND CONTRACT PUBLICATIONS:

- Responsible Uranium Mining and Milling: An Overview, Proceedings of the First International Conference on Uranium Mine Waste Disposal, Vancouver B.C., Canada, May 1980. *Category*
- An Analysis of the Draft EPA Ore Mining and Dressing Best Available Technology Report, prepared under contract to Natural Resources Defense Council, 1725 "I" Street, N.W., Suite 600, Washington, D.C. 20006, March 1980.
- Testimony Before the House of Representatives Committee on Interior and Insular Affairs, Subcommittee on Energy and the Environment Hearings on the Causes and Implications of United Nuclear-Churchrock Tailing Dam Failure, Washington, D.C., October, 1979. Available from Southwest Research and Information Center.
- Comments on the Generic Environmental Impact Statement on Uranium Milling, NUREG-0511, October, 1979, Available from Southwest Research and Information Center.
- Testimony before the House of Representatives Committee on Interior and Insular Affairs, Subcommittee on Energy and the Environment Hearings on the Nuclear Regulatory Commission's State Programs, July 19, 1979. Available at Southwest Research & Information Center.
- Summary of Recent Uranium Exploration Work in North Central New Mexico, March, 1979. Available from Southwest Research & Information Center.
- Comments on the Federal Coal Management Program Draft Environmental Statement, February, 1979. Available from Southwest Research & Information Center.
- Comments on the Star Lake-Bisti Coal Region Draft Environmental Statement, November, 1978. Available from Southwest Research & Information Center.
- Bokum Uranium Mill License Application Comments, September, 1978. Available from Southwest Research & Information Center.
- Analysis of Mobil/TVA's Interim Mining and Reclamation Plan for Pilot Testing of Insitu Leaching at Crownpoint, McKinley County, New Mexico, (May, 1978), June, 1978. Available at Southwest Research & Information Center.
- Temporal Change in the San Mateo Creek Drainage, Part of the Grants Mineral Belt, New Mexico, an Independent Research Project at Technology Applications Center, University of New Mexico, Albuquerque, May, 1978.
- New Mexico Uranium Inventory, Southwest Research & Information Center, P.O. Box 4524, Albuquerque, N.M. 87106, May, 1978.
- Comments on the Draft Environmental Impact Statement for Albuquerque Wastewater Treatment Facilities, August, 1977. Available at Southwest Research and Information Center.
- Statement for the Public Record of the Radiation Protection Hearing of January 20, 1978. Copies are available at Southwest Research and Information Center.

- New Mexico Uranium Industry Slide Shows, (1) Overview of technology and environmental impacts, 1977; (2) Development on Indian Land - aerial views, 1978; (3) Impacts of mines and mills -aerial views, 1979; and (4) United Nuclear Churchrock Tailings Dam Break - some aerial views, 1979. (Slides taken and scripts written by Wm Paul Robinson).
- Statement for the Public Records Regarding Priority List for Wastewater Treatment Works Construction Grants Funds, September 7, 1977. Available at Southwest Research & Information Center.
- Comments on the Draft Environmental Impact Statement for Albuquerque Wastewater Treatment Facilities, August, 1977. Available at Southwest Research & Information Center.
- Problems and Alternatives for the Navajo Indian Irrigation Project. Testimony before the U.S. Senate Committee on Environment and Public Works, Subcommittee on Water Resources, April, 1977.
- Alternatives for Confined Livestock Operations in the South Valley - Answers to a Community Problem. Copies are available at Southwest Research & Information Center.
- Application of the Dynamic Method of Flood Plain Mapping to Selected Developing Nations. ECOsystems International Inc., P.O. Box 225, Gambrills, MD 21054, June, 1975.
- User Requirements and User Acceptance of Current and Next Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources. ECOsystems International Inc., P.O. Box 225, Gambrills, MD 21054, June, 1975.
- Impact of Remote Sensing Upon the Planning, Management and Development of Water Resources. ECOsystems International Inc., P.O. Box 225, Gambrills, MD 21054, June, 1975.
- Summary and Projection of Septic System Requirements and Problems for Anne Arundel County, Maryland. ECOsystems International Inc., P.O. Box 225, Gambrills, MD 21054, March, 1975.
- Technology Assessment of Large Scale Organic Farming in U.S., Technology and Human Affairs Program, Washington University, St. Louis, MO. 63130, May, 1975.

EXPERT TESTIMONY:

- In State of New Mexico vs. City of Albuquerque, in the Bernalillo County District Court, No. CU-80-04500, a nuisance complaint concerning odors from an Albuquerque Sewage Treatment Plant, July 1980.
- In the Matter of the Groundwater Discharge Plan for the Ski and Tennis Ranch of Taos, New Mexico, July, 1979. Resumed January, 1980.
- In the Matter of the Groundwater Discharge Plan (DP-100)- Bokum Resources' Uranium Mill, January, 1980.
- Before the Minnesota House of Representatives Committee on Environment and Natural Resources Informational Briefing on Uranium Mining and Processing, St. Paul, Minnesota, December, 1979.

- In the Matter of National Pollutant Discharge Elimination System Permit for Bokum Resources Corporation, NPDES No. NM0028215, December, 1979.
- In the Matter of National Pollutant Discharge Elimination System Permit for Phillips Uranium Corporation, NPDES No. NM0028274, December, 1979.
- Before Royal Commission of Inquiry-Health and Environmental Protection-Uranium Mining Vancouver, British Columbia, Canada. December, 1979.
- In the Matter of Groundwater Discharge Plan (DP-43)- Bokum Resources' Marquez Uranium Mill, May, 1979.
- In the Matter of Amendments to the New Mexico Radiation Protection Regulations, May, 1979.
- In the Matter of National Pollutant Discharge Elimination System Permit for Ranchers Exploration and Development Corporation, NPDES No. NM0026573, September, 1978.
- In the Matter of National Pollutant Discharge Elimination System Permit for Kerr-McGee Nuclear Corporation, NPDES No. NM0020532, May, 1978.

MEMBERSHIP:

- Federation of Rocky Mountain Section Water Pollution Control Federation
- New Mexico Geological Society.
- American Association for the Advancement of Science.
- American Public Health Association, Environment and Radiological Health Sections.

plied Research Laboratories, Sunland, Calif., 1974).

20. J. D. Chase, *J. Appl. Phys.* **42**, 4870 (1972).
21. B. Walde, in *Conference Proceedings, International Round Table on the Study and Applications of Transport Phenomena in Thermal Plasma* (Laboratoire des Ultra Refractaires du C.N.R.S., Odeillo, Fontromeu, France, September 1975).
22. G. W. Dickinson and V. A. Fassel, *Anal. Chem.* **41**, 1021 (1969).
23. S. Greenfield, L. Jones, H. M. McGeachin, P. B. Smith, *Anal. Chim. Acta* **74**, 225 (1975).
24. R. H. Scott, V. A. Fassel, R. N. Kniseley, D. E. Nixon, *Anal. Chem.* **46**, 75 (1974).
25. J. Mermet, *Spectrochim. Acta Part B* **30**, 383 (1975).
26. G. R. Kornblum and L. de Galan, *ibid.* **32**, 71 (1977).
27. J. M. Mermet and C. Traisy, *Rev. Phys. Appl.* **12**, 1219 (1977).
28. J. Jarosz, J. M. Mermet, J. R. Robin, *Spectrochim. Acta Part B* **33**, 55 (1978).
29. P. W. J. M. Boumans and E. J. de Boer, *ibid.* **32**, 365 (1977).
30. R. Herrmann, C. T. J. Alkemade, P. T. Gilbert, *Chemical Analysis by Flame Photometry* (Interscience, New York, 1963).
31. V. A. Fassel and D. A. Becker, *Anal. Chem.* **41**, 1522 (1969).
32. G. E. Larson, V. A. Fassel, R. H. Scott, R. N. Kniseley, *ibid.* **47**, 238 (1975).
33. P. W. J. M. Boumans and E. J. de Boer, *Spectrochim. Acta Part B* **31**, 355 (1976).
34. I am indebted to R. K. Winge for making these observations.
35. I am indebted to H. Sobel and W. Sutherland for making these observations.
36. C. C. Butler, R. N. Kniseley, V. A. Fassel, *Anal. Chem.* **47**, 825 (1975).
37. J. C. Soudant and R. P. Robin, *Analyst* **1**, 427 (1972).
38. P. W. J. M. Boumans and E. J. de Boer, *Spectrochim. Acta Part B* **30**, 309 (1975).
39. I am indebted to B. Beau, M. Floyd, and W. Sutherland for making these determinations.
40. These detection limits represent the range of values reported in (9) and in J. D. Winefordner, J. J. Fitzgerald, N. Omenetto, *Appl. Spectrosc.* **29**, 369 (1975); *Techniques and Applications of AA* (AA-322G, Perkin-Elmer Corp., Norwalk, Conn., 1978).
41. S. J. Weeks, H. Haraguchi, J. D. Winefordner, *Anal. Chem.* **50**, 360 (1978).
42. R. L. Dahlquist and J. W. Knoll, *Appl. Spectrosc.* **32**, 1 (1978).
43. G. E. Larson, V. A. Fassel, R. K. Winge, R. N. Kniseley, *ibid.* **30**, 384 (1976).
44. G. E. Larson and V. A. Fassel, paper No. 23 presented at the fourth annual meeting of the Federation of Analytical Chemistry and Spectroscopy Societies, Philadelphia, 7 to 11 November 1977.
45. V. A. Fassel, J. M. Katzenberger, R. K. Winge, *Appl. Spectrosc.*, in press.
46. R. K. Skogerboe, P. J. Lamothe, G. J. Bastaans, S. J. Freeland, G. N. Coleman, *ibid.* **30**, 495 (1976).
47. S. R. Kortyohann, E. D. Glass, D. A. Yates, E. J. Hinterberger, E. E. Lichte, *Anal. Chem.* **49**, 1121 (1977).
48. W. J. Haas, R. K. Winge, V. A. Fassel, R. N. Kniseley, paper presented at the 29th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, 27 February to 3 March 1978.
49. S. Greenfield, H. M. McGeachin, P. B. Smith, *Anal. Chim. Acta* **84**, 67 (1976).
50. V. A. Fassel, *Am. Soc. Test. Mater. Spec. Tech. Publ.* **618** (1977).
51. —, C. A. Peterson, F. N. Abercrombie, R. N. Kniseley, *Anal. Chem.* **40**, 516 (1968).
52. M. B. Denton, personal communication.
53. A. L. Robinson, *Science* **199**, 1324 (1978).

NEWS AND COMMENT

Uranium Mill Tailings: Congress Addresses a Long-Neglected Problem

Some 30 city blocks from Utah's state capitol building and downtown Salt Lake City is a 128-acre site containing the radioactive residues from a long-since abandoned and dismantled uranium mill. From 1951 to 1964, the Vitro Chemical Company, now defunct, processed uranium ores to produce ^{208}U , or "yellow-cake," for the Atomic Energy Commission (AEC) and U.S. military programs. These operations left about 1.8 million tons of fine, sandy milling wastes or tailings right in the middle of what is now a metropolitan area of more than a half million people.

"Thousands of people work and live in close proximity to the [tailings] pile and are exposed to radioactive dust, radon gas, decay products of radon gas, and gamma radiation," Lyman J. Olsen, director of the Utah State Division of Health, told a congressional committee one day last summer. He was appealing for prompt action on legislation to clean up this site and a score of others scattered over the West, where tailings piles have been left from past uranium milling operations.

It now seems not unlikely that Congress will complete action before adjournment on legislation to deal with the mill tailings problem. Such legislation would have the Nuclear Regulatory Commission (NRC) and the Department of Energy take major new steps to clean

up a mess which the old AEC and its congressional overseers were slow to recognize and do anything about.

The tailings problem is large and ever-growing. Besides the 27 million tons of tailings found at inactive sites such as the one in Salt Lake City, another 113 million tons have accumulated at sites where uranium is currently milled. Given the rapid pace at which the uranium industry is now expanding to meet its contracts with electric utilities, there could be a billion tons by the year 2000.

At an active site, tailings first leave the mill as a slurry that is discharged into a pond contained on one or more sides by dikes which may themselves have been made (often none too securely) at least in part of dry tailings. Once the water in the ponds dries up or seeps away, what remains is a dry tailings pile which, unless stabilized and covered over, may be susceptible to wind and water erosion.

Some piles are immense, with the largest in the United States being the active and still growing pile maintained by the Kerr-McGee Nuclear Corporation at its big mill near Grants, New Mexico, where 7000 tons of ore are processed daily. Containing 23 million tons of tailings, it covers 265 acres and rises to 100 feet at its highest point.

The greatest hazard from mill tailings is associated with radon-222, a short-lived daughter of radium-226 found near

the end of a chain of long-lived radionuclides that begins with uranium (half-life, 4.5 billion years) and its daughter thorium-230 (half-life, 80,000 years). Unless covered deeply with clay and other material, a tailings pile may exhale radon gas at up to 500 times the natural background rate. Radon's daughter products can cause lung cancer and are responsible for the notoriously high incidence of this disease found in the past among uranium miners in Europe and the United States. The hazard is especially great in situations where radon gas can accumulate in a confined space.

Although the increases of radioactivity in the general environment attributable to tailings and radon gas are small they are never-ending, and significant health effects can be postulated, especially for people living in the regions where the piles are found. As Victor Gilinsky, a nuclear physicist and member of the NRC, has noted, unless the tailings are isolated from the atmosphere they will continue to release radon for more than 100,000 years, becoming "the dominant contribution to radiation exposure from the nuclear fuel cycle."

In fact, according to the American Physical Society's 1977 report on waste management and the nuclear fuel cycle, the ingestion hazard from tailings becomes greater than that from high-level wastes within the first 1000 years.

Whether any cancer cases have already resulted from radiation exposures associated with tailings remains to be documented. But public health authorities in states such as Utah and Colorado where the tailings piles are found are clearly apprehensive, especially with respect to those all too numerous situations where tailings have been used as a

fill material beneath homes or other buildings. It was recently reported with no little alarm, for example, that in the sleeping quarters of Salt Lake City's Fire Station No. 1, which was built on tailings some 20 years ago, the exposure to radon daughters is seven times greater than that allowed for uranium miners.

In view of such hazards, it is not surprising that Congress is finally moving to take remedial action, both with respect to eliminating (or otherwise dealing with) piles at inactive sites such as the one in Salt Lake City and to making sure that the hazards associated with present and future uranium milling operations are kept to an acceptable minimum.

The Senate passed a bill in mid-September to reinforce the NRC's authority to regulate tailings disposal (over the past 2 years the agency has been making

actual and prospective licenses under its purview adopt improved disposal practices). Also, under this bill states that have opted to license uranium mills themselves would have to follow standards at least as stringent as those of the NRC.

This latter guarantee is significant because the NRC has felt legally inhibited (unjustifiably so, the Council on Environmental Quality believes) from insisting that these states meet its substantive and procedural standards. Some states have not required even newly licensed uranium mills to adopt plans to isolate their tailings from the environment by means such as surface burial.

New Mexico, which produces nearly half of the yellowcake extracted from U.S. ores, is a case in point, although its licensing policies are now becoming

more demanding. Indeed, a comparison of some of New Mexico's past licensing actions with the NRC's reveals startling and ironic disparities.

For instance, a few years ago the state allowed the United Nuclear Corporation to adopt a tailings disposal plan for its mill at Church Rock which is no great improvement on the environmentally unacceptable disposal practices of the past. Yet about the same time, the NRC, in a proceeding involving another company's license application for a mill in Wyoming (where all mills are licensed by the commission), obtained a commitment to a surface burial plan that represented a marked advance.

The House of Representatives is expected, as of this writing, to take up shortly a tailings disposal bill which its Interior and Commerce committees have

Briefing

Nitrosamines Found in NIH-Approved Animal Feed

A group of scientists at a Waltham, Massachusetts, instrument firm has developed evidence that a laboratory animal feed recommended by the National Institutes of Health (NIH) for use in testing for suspect carcinogens may be contaminated with a significant amount of nitrosamines, which are themselves carcinogens. The findings raise the obvious possibility that, in animal tests with a suspect carcinogen, a heightened incidence of cancer in the test groups may in fact be due to the NIH feed and not to the suspect material.

The scientists—four from the Thermo Electron Corporation in Waltham and one from the Massachusetts Institute of Technology—also detected nitrosamine contamination in concentrations above 1 part per billion (ppb) in seven other commonly used animal feeds they tested.

Most of the amounts were small—less than 3 ppb—but the highest contamination level of all—52 ppb—was found in the NIH open formula rat and mouse ration. Developed several years ago as the ideal diet for small rodents in carcinogen bioassays, the NIH formula has been urged on most NIH contractors by federal officials, and is considered to be widely used.

Joseph Knapka, the NIH official who developed the feed, told *Science* that he is concerned about the finding and in-

tends to analyze other samples to determine if the problem is widespread. The scientists, who detected the contamination with a device they developed several years ago that is exquisitely sensitive to the presence of nitrosamines (*Science*, 23 January 1976), found lower but significant concentrations in other samples.

In response to a reporter's questions, officials at the National Cancer Institute (NCI) were quick to point out that the NIH feed has not been used in any of the NCI carcinogen bioassays now under way. Elizabeth Weisburger, head of the NCI Carcinogen Metabolism and Toxicology Branch, also said that presumably a control group of test animals on the same feed would also experience a heightened incidence of cancer: "As long as the test group is compared with the control group, there is no cause for concern."

Several of the Thermo Electron scientists, however, expressed concern that the nitrosamine feed contaminant could interact with the test substance to produce a synergistic effect. "The test group could have more cancers if the suspect carcinogen was only a promoter and the feed was the initiator," said Gordon Edwards, a toxicologist. He added that he and his group were not certain that the level of contamination they detected was enough to have this effect, but suggested that "feeds should be screened for nitrosamine in future bioassays, particularly when the test substance is fed to rodents in low doses."

Under NIH specifications, the feed, which contains 13 major ingredients, plus vitamins and minerals to ensure a nor-

mally healthy laboratory rat and mouse population, is already screened for 14 contaminants. Edwards and his colleagues suspect that the source of the nitrosamine contamination is the 10 percent content of fish meal. Dimethyl amine, a precursor of nitrosamine, is a product of spoiled fish. "We suspect that a 15th screen will soon be added to the list," said Edwards.

DOE Appointment Prompts Environmental Heat

When Department of Energy (DOE) Secretary James Schlesinger appointed Ruth Clusen to the post of DOE assistant secretary for environment on 13 September, he immediately acquired the good will of the heretofore combative environmental constituents of that office. Clusen, 56, had just completed 4 years as president of the League of Women Voters, and considers herself "strongly identified with environmental goals."

Just as quickly, however, some of that good will evaporated when Clusen appointed her predecessor in the post, James Liverman, as her deputy, apparently at the request of higher officials in the department. Several environmental groups, including the Natural Resources Defense Council, the Environmental Policy Center, and Ralph Nader's Congress Watch, expressed concern that Liverman was retained and now serves as Clusen's sole deputy. Liverman didn't really

approved. Its provisions for strengthening federal and state regulation of tailings disposal are similar to those of the Senate-passed measure.

But, in addition, this bill would have the Department of Energy clean up all of the inactive piles except perhaps for a few for which some company might be made financially responsible. The federal government would pay 90 percent of the total cost, which has been estimated, perhaps optimistically, at about \$140 million; the states in which the piles are found would pay the other 10 percent.

The milling companies that created the piles will, it seems, not bear any of the cost of the cleanup. The rationale here is that the companies were operating under "cost-plus" contracts with the AEC that did not require or provide money for any better means of tailings disposal. In light

of the AEC's failures in this regard, the states that have the piles argue that the federal government should foot the entire bill for the cleanup, and a tailings bill recently reported out of committee in the Senate so provides.

Most of the 20 odd inactive piles are fairly remote from cities and towns, but several are not. The exceptions include the pile in Salt Lake City and two in Colorado, at Grand Junction and Durango.

The Salt Lake City pile is expected to receive priority attention. The numerous options studied for dealing with this pile range in price from as little as \$550,000 to more than \$30 million. The less expensive options would all leave the pile in place, although some would provide for a covering of dirt and vegetation.

Utah health officials are insisting on removal by rail of the pile and 2 feet of

radium contaminated earth beneath it to a remote desert site 90 miles west of Salt Lake City, where all of the material would be placed in a natural depression and covered over. In their view, such removal is the only remedy because, they say, to reduce the radon emanations from the pile to near background levels would require capping the entire 128-acre site with a 22- to 30-foot layer of soil or an 8-foot layer of cement.

The task that awaits at Salt Lake City tells something about the size and difficulty of the tailings cleanup overall. Actually, the Salt Lake City pile is small compared to certain of the other inactive ones, and is but a tenth the size of Kerr-McGee's giant active pile in New Mexico. Although the Kerr-McGee site is 15 miles or so from the nearest town, this 23-million-ton pile, along with a half-dozen

Briefing

try to represent environmentalists or ascertain the environmental viewpoint," says one public-interest lobbyist.

This concern was voiced prior to Clusen's swearing-in. In response to it, Clusen obtained an understanding with DOE officials that she would have a free hand in the selection of her deputies, according to several sources. Once in the post, however, the understanding was changed to mean that she would hire James Liverman and one other deputy, whom she has yet to name.

Liverman, a biochemist, had been acting assistant secretary since October 1977, when DOE was formed from the Energy Research and Development Administration, where he had the same post. Previously, he had been the general manager for biomedical research at the Atomic Energy Commission (AEC), and it was there that he became involved in the controversy that remains the major sticking point between him and environmental groups throughout Washington. Specifically, Liverman was a principal figure in the cancellation of an AEC contract with University of Pittsburgh epidemiologist Thomas Mancuso on the effects of exposure to low-level radiation at a nuclear power plant in Hanford, Washington. The study was canceled abruptly in 1974, allegedly because it showed a significant incidence of cancer among workers at the plant exposed to levels of radiation 10 to 20 times below the federal standard. Liverman has said he acted in good faith but may have erred in judgment in ordering the cancellation.

One effect of the controversy over the

cancellation, which is currently under investigation by the General Accounting Office and the AAAS, may be the removal by Congress of DOE's authority to conduct radiation research through the department that Clusen now heads.

Clusen has tried to assure outsiders that Liverman will have only administrative and not policy responsibilities in her office, which altogether is responsible for a \$300 million budget and more than 300 employees (both are small by DOE standards). Clusen said she intends to more often seek the views of outsiders and to "be a strong voice to the department on environmental concerns here."

Moss Announces Retirement

Among the 31 members of the House of Representatives who have announced their retirement this year is California Democrat John E. Moss, 63, who for the last 20 years has been one of the most vigorous congressional advocates of the public's right to government information and of congressional oversight.

Moss was the principal author of the Freedom of Information Act, which he describes as "taking 15 years to pass" and which will undoubtedly be his greatest legacy. He also sponsored a half dozen major bills in the area of consumer protection, including the act establishing the Consumer Product Safety Commission. But his major strength was in the area of regulatory and bureaucratic oversight from his base as chairman of an over-

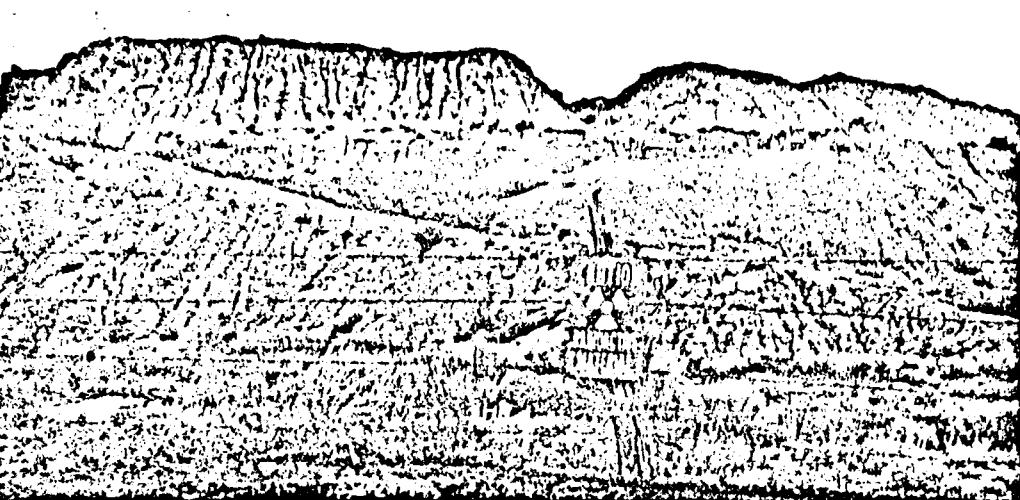
sight and investigations subcommittee. Through hearings, he publicized dozens of issues of concern to consumers, including TRIS-treated sleepwear, Firestone 500 tires, and the incidence of unnecessary surgery.

Typically, Moss used the hearing process to excoriate bureaucratic malingerers; witnesses who appeared before him were warned that his procedure was to start early, stay late, and be extremely tough. An oft-told story about him is the occasion when he was hearing testimony in the U.S. embassy in a Latin American country on waste in the U.S. foreign aid program. In the midst of the proceedings, in a crowded room with poor air-conditioning, the power failed and the lights went out, and everyone expected to go home. Out of the darkness, says one of Moss's staff aides, came the congressman's voice: "Mr. Ambassador, will you please bring in some candles?"

With such diligence that he has at times been described by colleagues as self-righteous, or a headline-hunter, Moss was able to kill through oversight hearings plans in the 1960's for a federal network of computers and spur federal agencies to enforce conflict-of-interest regulations for their employees. In 1976, his subcommittee produced a 400-page tome on the functioning of nine major regulatory agencies in Washington, appraising each according to its public responsiveness and recommending dozens of reforms.

Moss's decision to retire came largely as the result of declining health, due in large part to an auto accident last year.

R. Jeffrey Smith



An abandoned tailings pile in New Mexico's uranium belt. It is from a milling operation of 15 to 20 years ago by Phillips Petroleum. [Photo by Rudi Schoenmackers]

en other active and inactive ones in the Grants uranium belt, represents a significant regional source of radon gas. Yet to move all of these tailings and bury them would be something akin to moving and burying a small mountain.

What, then, should be done? A finding in the American Physical Society report bears solemnly on this question. "For long-term waste management, the hazard associated with radium [parent of the radon emanating from tailings] is more significant than that for plutonium [found in spent fuel and high-level waste from reprocessing]. In addition, for regional population exposure, radionuclides in uranium mill tailings are potentially at least as important as the actinide elements in high-level waste; the relative accessibility of mill tailings contrasts with the isolation proposed for other actinide-containing wastes." [Emphasis added.]

If this means that all tailings, including the accumulations from the past, should be buried, this is going to add a significant though probably not by any means unbearable cost to the nuclear fuel cycle. For tailings generated by new mills as yet unplanned and unbuilt, the disposal problem can be made much more manageable through a careful review of alternatives when an environmental impact statement is being prepared (in several uranium-producing states outside the NRC's purview, such as New Mexico, no such statements have been prepared).

In the case of tailings piles at active mill sites which were generated in whole or in part under AEC contracts, the government could well wind up paying a good share of the cost of ultimate disposal. Indeed, two such piles in New Mexico would be covered by the pending cleanup legislation. Although it is not included in the bill, the Kerr-McGee pile dates back to 1958 and is an outstanding example of so-called "commingled"

pile, containing both tailings from AEC contract operations and tailings from more recent operations under commercial contracts.

George L. Gleason, executive vice president of the American Nuclear Energy Council, was speaking for the uranium industry recently when he recommended to a congressional committee that existing mills and tailings piles in states such as New Mexico be exempted from having to meet NRC disposal criteria. "The retroactive application of [such] criteria could place an economic hardship on mill operations and disrupt production," Gleason said.

Another industry witness, Maxie L. Anderson, president of Ranchers Exploration and Development Corporation of Albuquerque (and one of the trans-Atlantic balloonists), noted that his company is able to reprocess, at a profit, tailings from a pile at Naturita, Colorado, thereby recovering uranium not captured in the relatively inefficient milling operation originally carried on at this site. But the uranium content of some if not most of the piles might not be great enough to make such processing and disposal ventures attractive to industry even if the government put up part of the money (as Anderson suggested would be appropriate in certain cases).

Since its establishment in early 1975 as a successor to the AEC, the NRC has been trying to turn over a new regulatory leaf with respect to tailings disposal, and, given the poor record of its forebear, it has had every reason to. During its long tenure the AEC failed to respond effectively to repeated and in some cases early warnings that proper tailings disposal had to be counted as an important part of radioactive waste management.

For instance, there was the discovery in the late 1950's by investigators from the Federal Water Pollution Control Agency (FWPCA) that tailings and other

wastes from the uranium mill at Durango had severely polluted the Animas River. Downstream in New Mexico, where the towns of Farmington and Aztec depended on the Animas for drinking water and farmers looked to it for irrigation water, there was such a protest that the FWPCA called an interstate pollution abatement conference.

To stop the outcry, the AEC directed its uranium mill licensees to "assure that concentrations of radioactive material in mill areas and in wastes discharged into streams are brought within permissible limits." This stopped the wholesale pollution of the Animas, but, without regulations to isolate the tailings from the forces of wind and water erosion, it was not enough. The Durango piles remained in place on a mountainside above the town, unstabilized and a clear hazard.

The fact is, the AEC still had not really acknowledged that tailings constituted a significant health hazard. Indeed, in September 1959, the agency authorized the Vitro Chemical Company to sell tailings from the Salt Lake City pile to a construction company for use as fill material. Such sales continued for a time until state health officials objected. Later, they verified that the tailings contained radium in disturbing amounts.

Yet, as H. Peter Metzger has reported in his book *The Atomic Establishment*, in the spring of 1962 (well after Utah health officials had put a stop to the sale of tailings as fill), the AEC was still avoiding the issue. An AEC official, responding to an inquiry from the milling company at Durango about use of tailings in construction work, chose not to answer the question but to reply simply that "tailings . . . are not subject to licensing requirements."

What finally forced the tailings problem to public attention was the astonishing discovery, which began unfolding in piecemeal fashion in early 1966, that hundreds of buildings in Grand Junction, Durango, and other places were contaminated with radiation from the use of tailings as fill. In 1972 the Congress was finally aroused to action and in that year it initiated a multimillion dollar project (with the state of Colorado paying a fourth) to decontaminate—by recovering the tailings fill—all buildings in the Grand Junction vicinity with radiation levels exceeding limits established by the U.S. Surgeon General. (According to a recent report of the General Accounting Office, the project has gone slowly; remedial work, on which \$6.5 million has been spent, is reported to have been completed at less than half of the 700 sites needing it.)

In 1974, the same year Congress was breaking up the AEC and beginning to look with a fishy eye at its Joint Committee on Atomic Energy, a step toward a more general cleanup was taken with the authorization of an engineering survey of inactive piles. Senator Frank Moss, from Salt Lake City, was a prime mover behind this legislation.

That the NRC began taking hold of the tailings problem shortly after it was created was, as commissioner Gilinsky has acknowledged, partly due to prodding from the Natural Resources Defense Council (NRDC), an environmental law group. The NRDC filed a petition with the new agency asking that a generic environmental impact statement (GEIS) on tailings disposal be prepared and that uranium mill operators be required to post a performance bond that would cover the cost of such improved practices as might ultimately be required.

The NRC agreed to prepare the GEIS (to be issued later this year), and while it did not immediately adopt the proposal for performance bonds it eventually did so. Also, by the spring of 1977, the agency had adopted a set of performance objectives for tailings management and was insisting that companies applying for NRC licenses or license renewals observe them.

One prime objective is to have all new

uranium mills sited remote from centers of population, and to have all tailings disposal sites so situated as to avoid or minimize "disruption and dispersal by natural forces." Another is to reduce, for tailings disposal sites new and old, gamma radiation to essentially background levels and radon emanations to about twice such levels. In addition, any need for continued monitoring and maintenance following tailings disposal and site reclamation would be eliminated.

An early practical test of these objectives came with a license application by the Rocky Mountain Energy Company of Denver, the mining subsidiary of the Union Pacific Corporation, to build a uranium mill in Wyoming in a joint venture with the Southern California Edison Company. This Bear Creek mill, already in operation on a company claim 70 miles northeast of Casper, is now disposing of its tailings in a carefully designed and engineered surface disposal facility but will eventually switch largely to subsurface disposal. All dry tailings will be backfilled into deep, specially prepared surface mining pits created in extracting the uranium ore; this disposal method will be similar to the United Nuclear Corporation's proposed Morton Ranch operation (near Douglas, Wyoming) which the NRC regards as a model.

The NRC is not insisting that its licen-

ses go to the large expense of removing existing tailings piles and burying them. Instead, it is requiring that these piles be regraded to resist erosion and then covered with clay and other soil to a depth (usually of 8 to 12 feet) sufficient to meet the objective of reducing radon emanations to twice background levels. Agency staff people say that such "above-grade burial" can be adequate, especially if the pile is nestled among terrain features and is not on an exposed site.

How disposal plans of the kind described above square with the new awareness of the hazards that mill tailings pose for the long term will no doubt be fully discussed at public hearings next year on the GEIS. Tailings quite obviously cannot be disposed of in geologic repositories in the manner proposed for high level and transuranic wastes; they are far too voluminous for that even if, from the standpoint of minimizing radiation exposure over the millennia, a case could be made for it. But there clearly is a question as to how far federal and state regulatory authorities should go in making concessions to economic expediency.

However such questions may be resolved, it is clear that the NRC and Congress have now begun in earnest to address the tailings disposal problem with the seriousness it deserves.

—LUTHER J. CARTER

Fermilab in Transition: The Wilson Era Ends

Fermilab—the 2-kilometer-diameter accelerator laboratory on the plains of northern Illinois—was the unique creation of Robert R. Wilson, an extraordinary builder, technical visionary, and architect who controlled almost every detail of his organization and forcefully directed the company's largest accelerator for 11 years.

When he resigned last February in an effort—ultimately unsuccessful—to get more money for his laboratory, the circumstances were unusual. There was the hint that he might be persuaded to return if more money somehow came along, and in any event, he requested that the board of trustees keep him on in a subordinate capacity while his erstwhile depu-

ty was promoted to be the new director. Indeed, the circumstances were unusual enough to raise questions about whether the old era of Wilson would be followed by a new era of Wilson, or whether his dominant influence on the laboratory—a controversial issue through much of his tenure—was ending.

Six months after Wilson's resignation, the delicate task of choosing new leadership has apparently come to a conclusion. As evidenced by the time required, resolution of the laboratory's quandary was not simple. Even after the board of trustees of the independent organization that directs Fermilab, University Research Associates, settled on a new director, difficulties with the funding

agency, the Department of Energy (DOE), delayed final approval. The department apparently had no objection to the person chosen by the board, but bureaucratic hurdles nevertheless held up the choice from mid-August to the present. Officials at the DOE say the last hurdles have been overcome and an announcement is due in a matter of weeks.

The new director is expected to be Columbia University physicist Leon Lederman, a talented and self-effacing experimentalist who has been closely connected with the laboratory from its beginnings in 1964. Having spent his research career working on a broad range of experiments performed in many different laboratories, and much of his time at Fermilab sparring with Wilson in a friendly fashion, Lederman is expected to bring a distinctive style to the laboratory. Well known as a charming humorist, Lederman is also rated high by his colleagues for his "taste in science," energy, toughness, and understanding of the factors that can bring a loss of vitality to a laboratory. If—as seems virtually