SCIENCE FOR DEMOCRATIC ACTION

an ieer publication

Volume 4, Number 4 Fall 1995

Update on NRC Decommissioning and EPA Cleanup Regulations

by Annie Makhijani

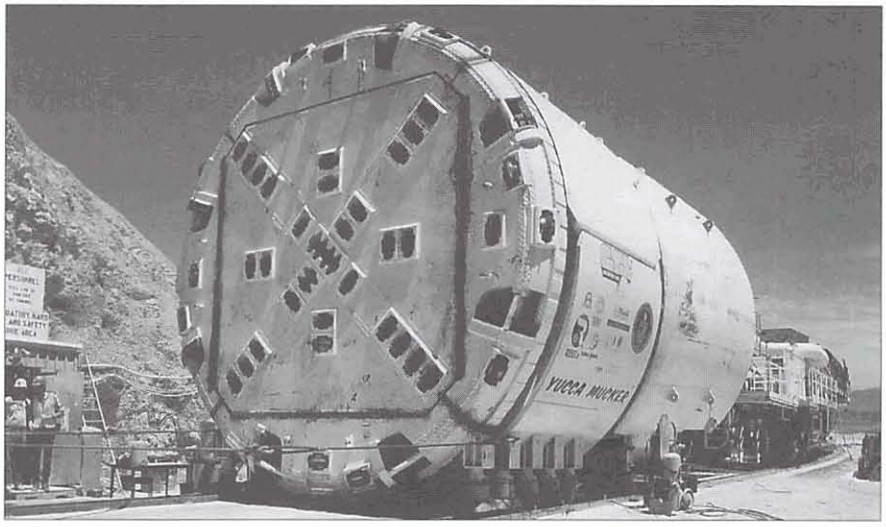
No comprehensive regulations currently exist for decommissioning and cleanup of radioactively contaminated sites. The Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC) have had a parallel, cooperative process to create the regulations, yet the final cleanup regulations continue to be pushed into the future. The Nuclear Regulatory Commission issued its proposed rule, "Radiological Criteria for Decommissioning" in the August 22, 1994 Federal Register. The final rule is currently scheduled to be published next spring. For IEER's comments on the proposed NRC regulations see *SDA* Volume 4 Number 3.

The EPA is also behind schedule. Its proposed Radiation Site Cleanup Regulations are expected to be promulgated in the winter of 1995-1996, and the final rule announced one year later.

Comments on EPA's Proposed Regulations

A May 11, 1994 preliminary staff working draft proposes regulations that set standards for the remediation of soil, surface water, groundwater, and structures at

See **Update**, *page 10*



The "Yucca Mucker," the tunnel-boring machine used to excavate the potential nuclear waste storage space under Yucca Mountain.

Editor's note: This is a lamentably long article, but possibly the most important so far published in Science for Democratic Action. So please read it, and send us your comments.

Calculating Doses from Disposal of High-Level Radioactive Waste:

Review of a National Academy of Sciences Report

by Arjun Makhijani

Some radioactive materials in nuclear waste will continue to pose threats of environmental contamination and disease for hundreds of thousands of years. The most dangerous of these wastes is called "high-level" waste, consisting of spent fuel from nuclear power plants and the most highly radioactive wastes from plutonium separation. Setting standards for disposal of these wastes to protect human health and the environment for the long time periods necessary is an exercise unprecedented in human history. Indeed, since the periods involved are far longer than any human institution and even civilization itself, creating a reasonable framework for setting the standards has itself been problematic.

See **Calculating Doses** *page 2*

Calculating Doses *from page 1*

The most recent in a long list of studies on the setting of standards was prepared by an *ad hoc* committee of the National Research Council of the National Academy of Sciences (NAS), chaired by Robert Fri of Resources for the Future in Washington, D.C. The NAS committee's report was mandated by the 1992 Energy Policy Act, in which Congress directed the Environmental Protection Agency (EPA) to develop a set of standards for high-level waste disposal specific to Yucca Mountain in Nevada.[1]

The NAS committee is explicit that it does not include the current goal of protecting ground water as a resource in its recommendations.

In the NAS report, *Technical Bases for Yucca Mountain Standards*,[2] fourteen of the committee's fifteen members recommend a method for assessing risk to future populations that has never been used before in radiation protection.[3] One committee member, Professor Thomas H. Pigford, among the country's leading nuclear engineers and one of the founders of the nuclear engineering department of the Massachusetts Institute of Technology, disagreed with the recommendation and filed a vigorous dissent.

The recommendations of the committee majority and the dissent by Pigford are an important part of the current national debate over science, risk, and environmental policy. In this article, I will review both the majority view and the dissent as they concern some aspects of radiation protection standards and the technical assumptions underlying the standards. The centerfold in this issue contains additional information on the report and related matters.

Background on Setting Exposure Standards

The principal basis for radiation protection until now has been to set limits on the maximum allowable exposures to individuals from man-made sources. For example, the overall individual dose limit for the general population from all sources of radiation (other than medical) is 100 millirem per year. The limit for exposure due to emissions from specific facilities is generally in the range of 5 to 25 millirem per year.

Setting limits on general population exposure is much more difficult due to the logistics involved in measuring doses to all individuals. In addition, the large number of sources of radiation, both natural and artificial, make it very difficult to pin down exposure to any particular source, unless it were large relative to all the others. Therefore, radiation protection of the general population, while aimed at limiting doses, is, in practice, often based on two key concepts: limiting the total releases of individual radionuclides (or groups of radionuclides); and limiting the

See **Calculating Doses** *page 3*

[1] Current U.S. law restricts the examination of a potential repository for high-level wastes to the Yucca Mountain site.

[2] Call 1-800-624-6242 or 202-334-3313 for a copy of the report published by National Academy Press, Washington, D.C., 1995. It is $39 plus postage. You can get an electronic copy for the cost of the phone call by logging on to EPA's bulletin board at 919-541-5742. To do so you must register as a user when you dial up (by modem) and then go to ORIA in the topics area. Once you are in that area, follow the route to waste and Yucca Mountain.

[3] The report notes that "the technique has not been applied to this problem in the past, as far as we are aware." (p. 145)

SCIENCE FOR DEMOCRATIC ACTION

Science for Democratic Action is published four times a year by the Institute for Energy and Environmental Research, 6935 Laurel Avenue, Takoma Park, MD 20912
Phone: (301) 270-5500 FAX: (301) 270-3029
Internet address: ieer@igc.apc.org

President	*Arjun Makhijani, Ph.D.*
Executive Director	*Bernd Franke*
Librarian	*Lois Chalmers*
Senior Scientist	*Kevin Gurney*
Bookkeeper	*Diana Kohn*
Project Scientist	*Annie Makhijani*
Outreach Coordinator	*Pat Ortmeyer*
Administrative Assistant	*Betsy Thurlow-Shields*
Scoville Fellow	*Hisham Zerriffi*

Subscriptions: As of the next issue of *Science for Democratic Action*, (Volume 5, Number 1), the newsletter will be **free to all readers** both within and outside the United States.

Science for Democratic Action Managing Editor: Pat Ortmeyer

Calculating Doses *from page 2*

concentrations of radionuclides in air, water or soil. Both of these concepts are incorporated into current standards for high-level waste repositories, codified in federal regulations 40 CFR 191.

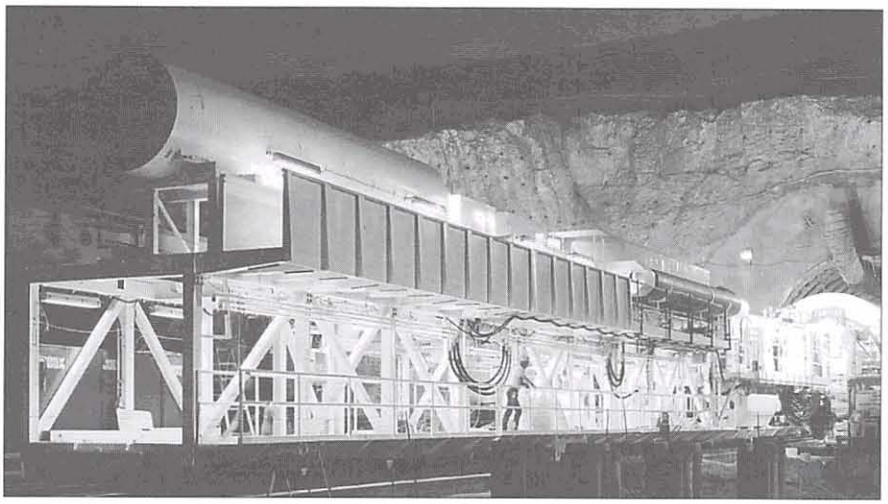
The first practice, limiting the total releases of individual radionuclides (or groups of radionuclides), limits the dose received by the total population. The second practice, limiting the concentrations of radionuclides in air, water or soil, limits the dose to the maximally exposed individual. If this individual is not exposed over a certain limit, then it follows that essentially all of the rest of the population would be exposed to health risks lower than those created by the upper limit of exposure. The "maximally exposed individual" is a hypothetical construct, corresponding to a set of "reasonable" assumptions about human needs and activities. People who may be unusually sensitive to radiation or who have unusual habits are not used for standard setting. For example, a British inquiry omitted people who subsisted mainly on clams from its definition of the affected population because this diet was considered unusual.[4]

When the main route of exposure over long time periods is expected to be via the use of water for drinking and subsistence farming, it is the general practice to use the "subsistence farmer scenario" for calculating exposure. This approach assumes that a person would unknowingly use contaminated water for drinking and farming and would grow all their own food.

For the purposes of calculating radiation dose, a small, homogeneous group of individuals is used to define a "critical group." The International Commission on Radiological Protection (ICRP) explicitly states that the critical group "represents an extreme" of radiation exposures within the entire population in the area in order "to ensure that *no individual doses are unacceptably high.*"[5] (emphasis added) It recommends that critical groups be small so that they are homogenous, with the *upper limit to size* usually being a "up to a few tens of persons" and they could be as small as only one person.[6]

The device of a small critical group is used to represent the maximally exposed individual for regulatory purposes. Once the exposure scenario for the maximally exposed individual is selected, then it is possible to derive secondary standards for limiting concentrations of radionuclides in air, water, and soil. These secondary standards, if adhered to, would result in compliance with the primary dose standard.

Since it is difficult or impossible to measure radiation doses and risks to the general population from particular radiation facilities, secondary standards that limit concentrations of radionuclides are essential to ensuring compliance with dose or risk limits. Setting secondary standards to protect the general population from radioactive contaminants is used throughout the world in radiological protection, including in the United States.



Tunnel Boring Machine entering the north portal of Yucca Mountain.

Standards Suggested by the NAS Committee

The NAS committee majority proposes to set aside the concept of setting secondary measurable standards in favor of limiting the *risk* to a critical group as defined in a new way (see below for further details). The principal argument for such a standard is that it directly addresses the thing we most want to limit: risk of damage to health, including cancer risk. In fact, the NAS committee is explicit that it does not include the current goal of protecting ground water as a resource in its recommendations. The report states that

See **Calculating Doses** *page 4*

[4] Committee on Technical Bases for Yucca Mountain Standards, *Technical Bases for Yucca Mountain Standards*, National Academy Press, Washington, D.C., 1995, p. 171.

[5] ICRP Publication No. 46, 1985, p. 9.

[6] ICRP Publication No. 43, 1984, p. 15.

Calculating Doses *from page 3*

the current EPA regulation for high-level waste disposal,

> 40 CFR 191, includes a provision to protect ground water from contamination with radioactive materials that is separate from the 40 CFR 191 individual-dose limits. These provisions have been added to 40 CFR 191 to bring it into conformity with the Safe Drinking Water Act, and have the goal of protecting ground water as a resource. We make no such recommendation, and have based our recommendations on those requirements necessary to limit risks to individuals. (p. 121)

If the EPA adopts the committee's proposal, there would be no explicit limits to the contamination of groundwater as such. It would be legally permissible for water to become highly contaminated, depending largely on the way the critical group was selected. The consequent radiation doses to some of the people using contaminated water could be very high.

The possibility of very high radiation doses, far above allowable limits, from consumption and agricultural use of water contaminated by a high-level waste repository at Yucca Mountain is real. Since water is scarce in the area, there is only a relatively small volume available (compared to other repository locations) to dilute leaking radionuclides (pp. 27-28 of the NAS report). A 1983 National Academy of Sciences study on repository disposal of nuclear waste estimated that peak doses could range from a low on the order of one rem (perhaps less) to about 1,000 rem per year depending on assumptions about the behavior of the waste and water travel time.[7] More recent studies done by Sandia National Laboratory and INTERA, both Yucca Mountain Project contractors, also estimate that peak doses from using water contaminated by a Yucca Mountain repository could be high. (See centerfold.)

If the EPA adopts the committee's proposal, there would be no explicit limits to the contamination of groundwater.

What About the Subsistence Farmer?

Could the NAS committee's recommendation of limiting risk to individuals be compatible with allowing high doses of radiation to maximally exposed individuals, and in particular to subsistence farmers? And are the committee majority's recommendations in conformity with the recommendations of the ICRP? These questions are at the heart of the dispute between the committee majority and the lone dissenter, Professor Pigford. Appendix C of the report, where the majority specifies the method to be used for calculating exposures, also appears to make contradictory statements (see below).

Here is my understanding of the eight-step process of determining the exposure of the critical group as described in Appendix C by the NAS committee majority. My own comments are italicized in parentheses.

1. Identify the population which contains the people at risk of getting the highest doses. "For purposes of illustration, this example assumes a farming community in the Amargosa Valley." *(The term "farming community" could include many occupations, not just subsistence farmers. It could be a large, inhomogeneous group, which would be incompatible with ICRP's recommendation for a critical group, or a small, homogenous group. For instance, it may consist of farmers, casino operators, and defense workers or it may have farmers only (see NAS report page 145. The farmers may or may not be subsistence farmers.)*
2. Quantify the demographic and geographical characteristics of the population so as to determine what areas in the region "have the potential for farming and groundwater use." If possible, limit the area for exposure analysis by excluding some areas, such as those not likely to be farmed or where groundwater might be too deep. *(On this basis, the area and groundwater in the immediate vicinity of the Yucca Mountain repository could be excluded from the calculations.)*
3. Identify the intersections of those areas that might be farmed and those beneath which radioactively contaminated water would be present at some time.
4. Model the release of radionuclides from the repository and take into account that the plume of contamination passes through various areas at different times, limiting exposure in this way. Model various possible ways in which the contaminated plume of groundwater might travel (these are called

See **Calculating Doses** *page 5*

[7] Waste Isolation Systems Committee, *A Study of the Isolation Systems for Geologic Disposal of Radioactive Wastes*, National Academy Press, Washington, D.C., 1983; pp. 264 and 278. Professor Pigford chaired the committee that prepared this study.

Calculating Doses *from page 4*

"plume realizations"). People living in such areas before the plume is directly under them will be "at no risk" during these periods.

5. Calculate doses for a large variety of possible conditions and times, sampling from among the various plume realizations. *(This step acknowledges, in contradiction to the one just above, that people "outside the area overlying the plume" could be exposed due to "local export of water or food.")*

6. Calculate the times at which the groundwater under various exposed populations would be most contaminated.

7. Divide the results of each groundwater contamination ("plume realization") into geographical subareas in which doses are to be arithmetically averaged. The population of each subarea should be large enough "to allow computation of a meaningful average dose." Then define a "critical subgroup" consisting of all subareas with average risks within a factor of ten of the "maximum average" subarea risk. *(The term "meaningful average" is not defined. This requirement could, in some cases, conflict with the ICRP recommendation that the critical group be small.)*

8. Average the average doses for the critical subgroups in Step 7 for each plume realization. This final average of averages is defined by the committee majority to be the "technically appropriate representation for the critical-group risk."

Better repository design is the proper means of obtaining low doses, not nonscientific policy fixes. — Professor Thomas H. Pigford

Appendix C does not explicitly say so, but the report implies that the method, while admittedly new, is consistent with the ICRP's recommendations for the selection of a critical group, except that the committee uses risk in place of dose. For instance, the summary of the report states (pp. 5–6):

> We recommend that the critical-group approach be used in the Yucca Mountain standards.
>
> The critical group has been defined by the International Commission on Radiological Protection (ICRP) as a relatively homogeneous group of people whose location and habits are such that they are representative of those individuals expected to receive the highest doses...

The committee's own definition of critical group in the body of the report corresponds approximately to the ICRP critical group method. The

> critical group for risk should be representative of those individuals in the population who, based on cautious, but reasonable, assumptions, have the highest risk resulting from repository releases. The group should be small enough to be relatively homogenous with respect to diet and other aspects of behavior that affect risks. (p. 53)

This definition is close to that of the ICRP definition in that *it is representative of persons at highest risk in the critical group and requires that the critical group be "small,"* though, unlike the ICRP, the committee did not explicitly define the term "small."

Professor Pigford's Dissent

The central points of Pigford's dissent (in Appendix E of the report) are as follows:

- The committee majority has abandoned the subsistence farmer scenario which is the surest, most conservative method for protecting all future populations. It is in conformity with the recommendations of the ICRP. It is also the radiation protection method of choice worldwide, including in the United States, Britain, Sweden, Switzerland, Finland, and Canada. He cites the British National Radiological Protection Board's advice, for instance, according to which the critical group would consist of people "at the place where the relevant environmental concentrations are highest, and [who] have habits such that their exposure is representative of the highest exposures that might reasonably be expected."
- "There is consensus that the subsistence-farmer approach is consistent with the critical group concept." Pigford cites several examples, including one in which the U.S. Nuclear Regulatory Commission used a subsistence farmer family of three as the critical group.
- The probabilistic critical group approach recommended by the majority "is demonstrably less stringent in protecting public health than the subsistence farmer approach." The example of the farming community in the Amargosa Valley used by the committee majority would contain part-time

See **Calculating Doses** *page 6*

Calculating Doses *from page 5*

farmers, but "the full-time subsistence farmer will not be found on that distribution." The probabilistic critical group method is not in conformity with the recommendations of the ICRP.

- The method is subject to manipulation because it permits arbitrary choices of parameters such as population characteristics and sizes of subareas. Such choices could lower the calculated doses which would provide "an illusion of safety, but with a serious loss of credibility."
- The "[c]alculational techniques described in Appendix C are not mathematically valid."

In a later explanatory note, Pigford noted that the method "would introduce unjustified and unprecedented leniency in public health protection from radioactive waste." He concluded that the "probabilistic exposure scenario will be perceived by many as a disguised means of reducing the calculated individual doses below the high values (ca. 10 rem/year) that were presented to the committee. Better repository design is the proper means of obtaining low doses, not by nonscientific policy fixes. Policy makers must reject pressures for short-term expediency and economy, lest, by enacting policy that compromises scientific validity and credibility, it undermines public confidence and puts an end to all further nuclear development and research."[8]

Indeed, the calculational procedure set forth by the committee majority could allow for the exclusion of the subsistence farmer entirely (see below). In that case, the NAS committee would extend the definition of people with "unusual habits" from those whose diet consists almost entirely of clams to subsistence farmers, which is one of the most common occupations in the world today.

Not Mathematically Valid?

In some ways, Pigford's charge that the method in Appendix C is *not mathematically valid* is a very surprising one to remain standing after the work of the committee was complete. Even more astonishing, Pigford has stated that none of the members of the committee or any of the reviewers even responded to his claim of the mathematical invalidity of the method during the course of the study.[9] The lack of a response to such a basic charge is most unusual and raises serious questions about the integrity of the scientific process by which the committee majority decided that its recommendation of a new, complex, and untried method in radiation protection was a workable one. Therefore, I explore the matter at some length here.

The committee does not seem to have done an extensive check of its own to prove that the model is consistent with the ICRP.

The essence of Pigford's claim of mathematical invalidity is that the method in Appendix C does not result in a critical group that corresponds to a critical group as defined by the ICRP, as the committee would claim. This is because Step 7 of the calculational process divides the "region into subareas, with no homogeneity requirement for the subarea." This means the doses to individuals within the subarea can be very different. A few individuals with high doses could be averaged in with a large number of individuals with low doses, resulting in a low average dose (or risk) for the area.

ICRP recommendations require that the individuals with the highest dose (or risk) be part of the critical group. But in the method of Appendix C, the averaging process over a subarea could result in the highest exposed individuals being in a subarea that has a low average dose. This could result in their exclusion from the critical group defined in Step 8 of Appendix C because there may be many subareas with a higher *average* dose (or risk), *but which do not include the individuals with the highest dose* (or risk).

The disagreement has not been resolved. My own preliminary conclusion is that Pigford's is right to conclude that Appendix C is not a mathematically valid approach to creating a critical group in conformity with ICRP's recommendations. While Pigford was a minority of one in the committee, the widespread use of the subsistence farmer approach and its clear conformity with the ICRP method shows that he is, in fact, in the majority in the scientific world at large on this issue.

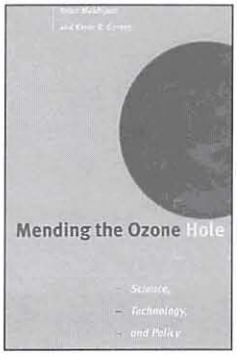
While disagreements about policy abound, and there is wide

See **Calculating Doses** *page 12*

[8] Thomas H. Pigford, "Invalidity of the Probabilistic Exposure Scenario Proposed by the National Research Council's TYMS Committee," UCB-NE-9523, Nuclear Engineering Department, University of California, Berkeley, November 1995. In this note, Pigford also adds Japan to the list of countries using the subsistence farmer scenario.

[9] ibid.

SELECTED PUBLICATIONS



Mending the Ozone Hole

Science, Technology, and Policy

MIT Press, 1995

by Arjun Makhijani and Kevin Gurney

This comprehensive overview details the most current knowledge about stratospheric ozone depletion. More than a review of the evolution of the ozone problem, *Mending the Ozone Hole* provides an objective and stimulating look at current debates surrounding the research, technology development, and policy-making aimed at eliminating ozone-depleting substances.

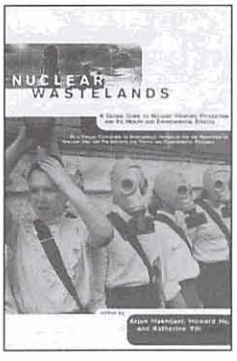
This book presents an overview of the stratospheric ozone-depletion problem, including scientific, technological and policy issues. The work is an original and significant contribution to the field in terms of presenting an integrated perspective.

—Mario Molina, 1995 Nobel Prize Winner, Professor of Atmospheric Chemistry, Massachusetts Institute of Technology

I do not know of any other work with the same bredth and scope.

—Ralph J. Cicerone, Professor of Earth Systems, Univeristy of California at Irvine

List price: $35.00. SDA readers discount price: $27.50 (postage included)



Nuclear Wastelands

A Global Guide to Nuclear Weapons Production and Its Health and Environmental Effects

MIT Press, 1995

(a joint publication by IEER and International Physicians for the Prevention of Nuclear War)

edited by Arjun Makhijani, Howard Hu, and Katherine Yih

A handbook for scholars, students, policy makers, journalists, and peace and environmental activists, *Nuclear Wastelands* provides concise histories of the development of nuclear weapons programs of every declared and de-facto nuclear weapons power. It also surveys the health and environmental effects of this development both in nuclear countries and in non-nuclear nations involved in nuclear weapons testing and uranium mining. Its thorough documentation and analyses bring to light governmental secrecy and outright deception that have camouflaged the damage done to the very people and lands the weapons were meant to safeguard.

No future research into nuclear weapons will be credible unless it refers to this study.

—Jonathan Steel, *The Guardian* (UK), August 9, 1995

List price: $55.00. SDA readers discount price: $40.00 (postage included)

Fissile Materials In a Glass, Darkly

IEER Press, 1995

by Arjun Makhijani and Annie Makhijani

IEER's report analyzes the options for disposition of plutonium and highly enriched uranium. It recommends policies designed to put these materials into non-weapons-usable forms as rapidly as possible. It urges that the U.S. adopt vitrification of plutonium as its disposition option (rather than using it in reactors) in order that the U.S. may persuade countries still separating plutonium from civilian spent fuel to stop doing so.

PRICE: $12 including postage and handling.

IEER and Physicians for Social Responsibility (PSR) have joined together to produce a series of fact sheets dealing with fissile materials. Each fact sheet is approximately 2 pages long and written in clear, understandable language. The first two fact sheets in the series are:

Fissile Material Basics

This fact sheet describes what fissile materials are, how they are made, and what they are used for.

Fissile Material Health and Environmental Dangers

This fact sheet outlines the health and environmental dangers of plutonium and uranium and their production processes.

Other free fact sheets still available from IEER:

- **Physical, Nuclear, and Chemical Properties of Plutonium**
- **Uranium: Its Uses and Hazards**
- **Incineration of Radioactive and Mixed Waste**

TO ORDER BOOKS:

Please send us a check for the appropriate amount, made out to IEER, and a letter clearly stating the quantities and titles you would like. Please see below for our address.

TO ORDER FREE FACT SHEETS:

Simply write to IEER, attention FACT SHEET, 6935 Laurel Avenue, Takoma Park, MD 20912.

A CENTERFOLD FOR TECHNO-WEENIES

Yucca Mountain Exposure Scenarios

Why Yucca Mountain?

The chart below explains the chronology of events that led to the choice of Yucca Mountain as the only potential repository to be investigated for the disposal of high-level waste in the U.S. It also discusses related and upcoming events.

A Brief Yucca Mountain Chronology

Date	Action or Legislation
1982	**Nuclear Waste Policy Act** Mandates 2 repositories, one west, one east.
1987	**Nuclear Waste Policy Act Amended** Yucca Mountain chosen as only site for investigation
1992	**Energy Policy Act** NAS asked to form a panel for advising EPA on special standards for Yucca Mountain.
1995	**National Academy of Sciences Report** NAS panel issues a report advocating a new basis for Yucca Mountain standards, with one dissent.
1996	**Environmental Protection Agency** EPA plans to release Draft Standards for Yucca Mountain in late spring.

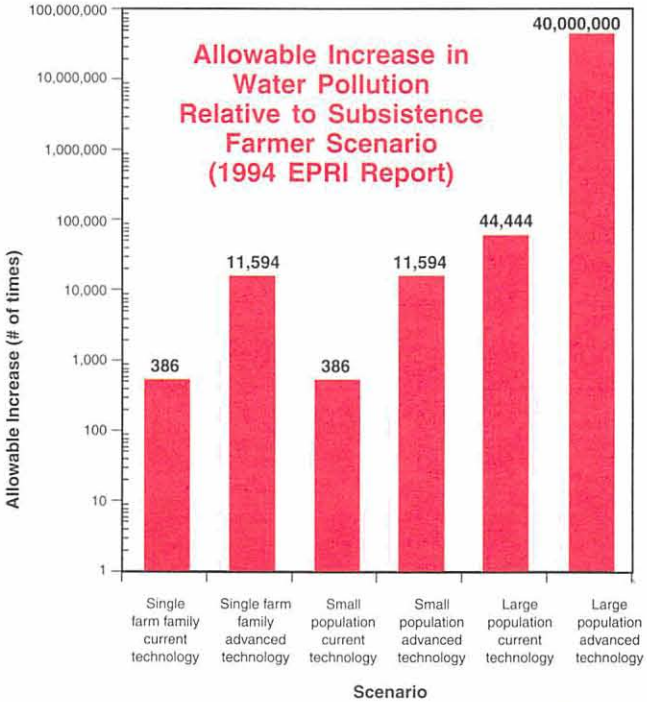
DEPARTMENT OF ENERGY

Yucca Mountain, looking toward the southeast.

Setting Allowable Groundwater Contamination Levels—the EPRI Report

A report produced by the Electric Power Research Institute (EPRI) in 1994 considers several scenarios which examine the likelihood of future populations using contaminated water at Yucca Mountain. (Single farm families, small and large populations, and for each, current and advanced technologies.) The results show that the lower the probability of future use averaged over some population, the higher the increases in allowable groundwater contamination to produce the same calculated dose or risk (as distinct from the real dose and risk).

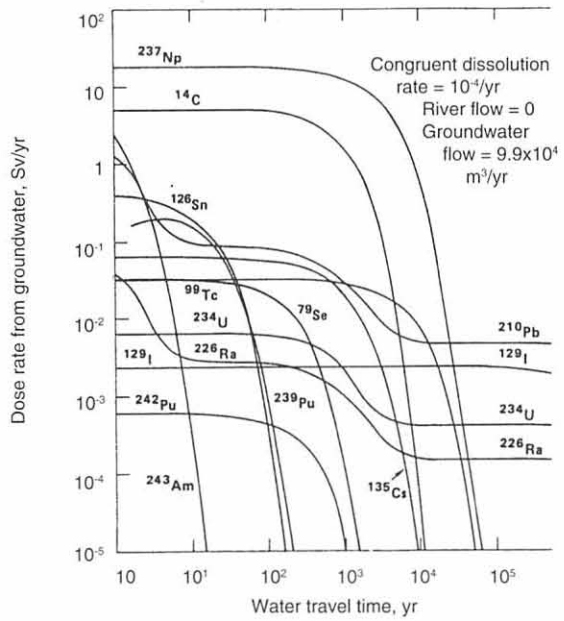
Interestingly, the EPRI report does not explicitly draw out this conclusion. This table shows how each scenario corresponds to increases in allowable water contamination over the "subsistence farmer" level. (Note: Graph is in log scale.) Anything even approaching the higher end of this range would be more appropriately described as toxic soup rather than water.



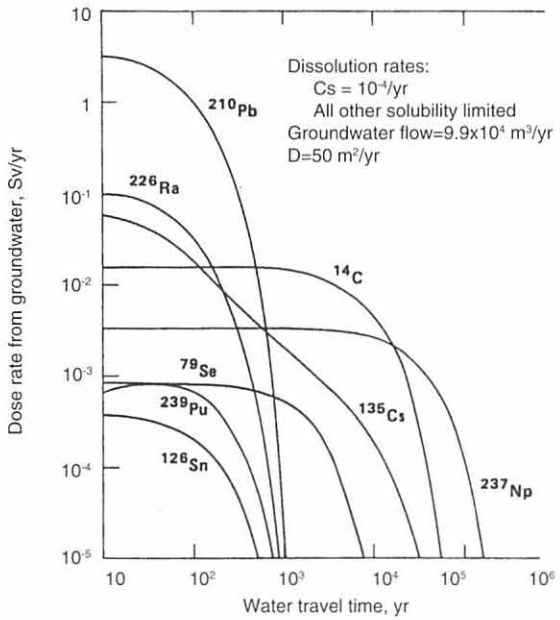
Other Exposure Scenarios and Contamination Levels

In addition to the EPRI report, the NAS (1983), Sandia National Laboratories (1994) and a Yucca Mountain contractor, INTERA, Inc. (1993) also issued reports on exposure scenarios for Yucca Mountain. The charts below are the dose estimates as published. We invite SDA readers to make sense of them. The table relates these doses to suggested EPA and NAS dose limits.

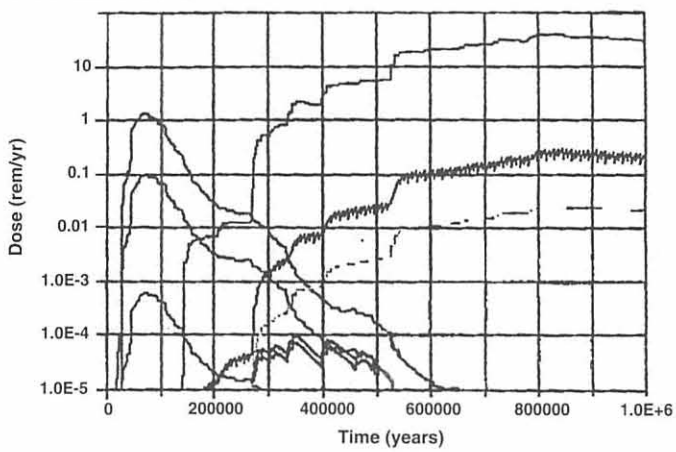
NAS INDIVIDUAL RADIATION DOSE, WORST-CASE SCENARIO (1983)



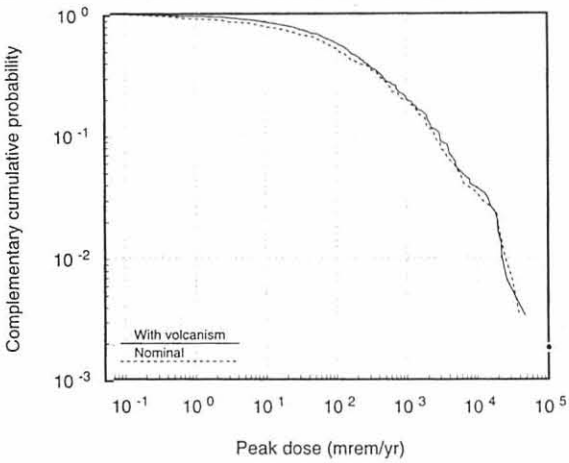
NAS INDIVIDUAL RADIATION DOSE, BEST-CASE SCENARIO (1983)



INTERA (1993)



SANDIA PEAK DOSE SCENARIO (1994)



Dose Estimates for Yucca Mountain Site Compared to Dose Limits

Scenario	Possible Dose (rem/yr.)	# of times over EPA limit of 25 mrem/yr.	# of times over 1983 NAS Recommended Max. of 10 mrem/yr.
NAS 1983 Worst-Case	1,000	40,000	100,000
NAS 1983 Best-Case	1	40	100
INTERA 1993	30	1,200	3,000
Sandia 1994	20	800	2,000

Update, *from page 1*

federally owned sites to be release to the public.[1] The proposed maximum radiation dose to members of the public is 15 millirem (mrem) per year in excess of natural background radiation and would apply for a period of 1,000 years after completion of remediation. However, the EPA estimates that because the remediation activities must ensure that the concentrations of radionuclides in groundwater do not exceed the Maximum Contaminant Levels (MCLs) developed under the Safe Drinking Water Act, the actual dose to the public will be further limited[2]. (The MCLs of the Safe Drinking Water Act limit exposures from ground water to no greater than 4 mrem per year.) The EPA is currently revising the MCLs which are found in the National Primary Drinking Water Regulations (40 CFR 141, 142)[3]. The EPA first published these proposed revisions in the Federal Register on July 18, 1991. The adoption of the final rule will be announced on December 15, 1995.

The NRC would even like to relax the existing patchwork of guidelines.

In addition, the EPA May 1994 working draft proposed the inclusion of radon concentration limits for existing as well as future residential and commercial structures on the site. This was done to comply with the guidelines of the EPA Radon Program as well as any other applicable federal, state, or local government regulations and/or guidance. (The EPA radon program is otherwise a nonregulatory program which recommends remediation for levels of radon-222 above 4 picocuries per litre [4 pCi/l]of air.) Under the proposed rules, 4 pCi/l would become EPA's standard. However at this time, one-and-a-half years later, it appears that this radon standard may not be included in the proposed rule. It also appears that Naturally Occurring Radioactive Materials (NORM), wastes originally included, may also not be part of the proposed rules.[4]

Like the NRC, the EPA proposed rules would have provisions in the event the site remediation does not meet the criteria for unrestricted residential use. The owner of the site would then be required to "implement active control measures" to ensure that individuals located at the site do not receive a dose exceeding 15 mrem per year overall and no more than 4 mrem per year from groundwater. In the event these active control measures fail, individuals should not be exposed to doses exceeding 75 mrem per year.

Comments on NRC's Proposed Rules and its Site Decommissioning Management Plan

Although the NRC's proposed regulations are an improvement over its previous patchwork of guidelines, the loopholes worked into it would allow higher levels of residual contamination to be left behind than stipulated. The sites currently being decommissioned under the Site Decommissioning Management Plan (SDMP) will be exempt from the criteria of the final rule. But a recent NRC document, SECY-95-209, dated August 11, 1995, contains numerous indications that under the guise of expediting decommissioning and cost reduction, the NRC would even like to relax the existing patchwork of guidelines.[5]

One way of achieving this would be to reduce the scope of NRC's confirmatory surveys.[6] The NRC realizes that this would increase the risk of elevated levels of residual radioactivity in isolated spots, or "hot spots", and candidly admits that "with the reduced scope of confirmatory surveys and measurements, it is possible that a licensee could attempt to deceive the NRC through a concerted effort by falsifying data or intentionally biasing sampling results and survey measurements." However the NRC has two ways of fixing that problem. The first would revise the "hot spot guidance" to allow higher levels of radioactivity. The second would put more emphasis

See **Update** *page 11*

[1] The proposed regulations exclude sites for which regulations already exist. They are sites regulated under 40 CFR 191, parts B and C, disposal of spent fuel, high level and transuranic wastes; 40 CFR 192, disposition of thorium and uranium mill tailings; and 40 CFR 300, national oil and hazardous substances pollution contingency plan required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

[2] The groundwater pathway is expected to contribute far more to the radiation dose than would air and soil pathways.

[3] For a tabulation of current and proposed MCLs refer to SDA, Volume 3, Number 1.

[4] NORM wastes are the result of diverse activities such as oil and gas production, uranium mining, phosphate fertilizers production, etc. Radium-226 is the principal radionuclide of concern. In soil, radium-226 average concentration is 1 pCi/g; in uranium mining overburden the average concentration is 25 pCi/g; and in oil and gas production scale and sludge it is 360 pCi/g and 75 pCi/g respectively. In some cases, such as the oil and gas industry, the concentration of radium-226 can be as high as 400,000 pCi/g. Such wastes are often generated in huge quantities.

[5] This SECY is a biennial update to the "Site Decommissioning Management Plan" (SDMP).

[6] Confirmatory surveys, although not mandatory, are routinely conducted by the NRC to verify that the licensee meets the NRC criteria. The NRC states that: "This documentation has, in the past, been shown to be reassuring to the members of the public".

Update, *from page 10*

on reviewing the licensee's termination survey plans and reports.

The NRC also has several policy proposals under review. Some are:

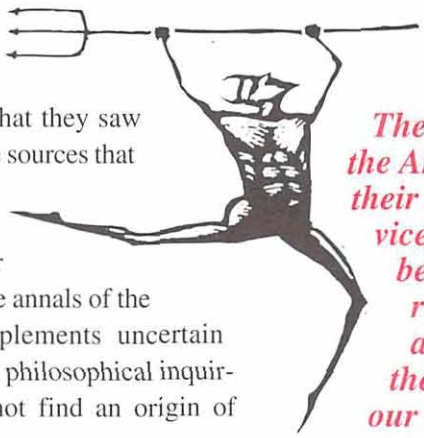
- *Concentration averaging*: The licensee would be allowed to mix contaminated soil with uncontaminated soil, ("dilution is the solution to pollution").
- *Assumptions for exposure assessment scenarios*: The NRC is initiating reviews of the dose assessment methodology on the grounds that the modeling used tends to overestimate the potential doses by an order of magnitude or more. Different assumptions, such as lowering the lifetime exposure or assuming no intrusion, would result in lower exposures for the same amount of residual radioactivity left on site.
- *Generic conclusions on disposal of uranium and thorium wastes*: For some of the sites which will not be able to meet the proposed criteria, the NRC has initiated the development of site-specific environmental impact statements (EISs) to consider the effects of onsite disposal of contaminated wastes. After review and evaluation, if the NRC determines that any generic conclusions can be drawn, it will consider developing a generic EIS instead of preparing an EIS for every site.
- *Institutional controls*: The NRC is proposing that sites which cannot be released to the public for unrestricted use be accepted by the DOE for long-term management under section 151 (b) of the Nuclear Waste Policy Act. The provision that "the licensee set aside sufficient funds to ensure that long-term custody would be at no cost to the Federal government" frees the corporation from all responsibilities even if in the future the funds are found to be insufficient. If funds do run out, the corporation's liabilities are transferred onto the taxpayer.

These proposals are examples of backsliding on environmental protection which are part of a larger picture. Another example of such a proposal is found in the National Academy of Sciences report on Yucca Mountain. (See main article in this issue.)

Dr. Polly C. Wonk Returns!

Dr. Wonk, IEER's esteemed consultant and imparter of advice to Washington officialdom, has returned from her extensive travels in 18th century France. So inspired was she by her interviews with philosopher J.J. Rousseau that she chose to forego her usual Federal Forum style to share a few of J.J.'s timely words of wisdom with SDA readers:

According to an ancient tradition passed on from Egypt to Greece, a God inimical to men's repose was the inventor of the sciences. What, then, must the Egyptians themselves, among whom the sciences were born, have thought of them! It is that they saw near at hand the sources that had brought them forth. Indeed, whether one consults the annals of the world, or supplements uncertain chronicles with philosophical inquiries, one will not find an origin of human knowledge that corresponds to the idea one would like to hold regarding it. Astronomy was born of superstition; Eloquence of ambition, hatred, flattery, lying; Geometry of avarice; Physics of a vain curiosity; all of them, even Ethics, of human pride.



The Sciences and the Arts thus owe their birth to our vices; we should be less in doubt regarding their advantages if they owed it to our virtues.

Credits for this Issue

Production:
Judy Lutts of Cutting Edge Graphics, Washington, D.C.

Photos:
Department of Energy

Errata

In the "Dear Arjun" section of Volume 4, Number 3, footnote 1 should read "The various guidelines and standards have been discussed in the Centerfold for Technoweenies of *SDA*, Volume 3, Number 1."

1995 at IEER

Compiled by Tessie Topol

1995 was an exciting and productive year for IEER. Below are some of the highlights.

Plutonium as a Liability

- January: Hosted an International Symposium on Weapons-Usable Fissile Materials
- April/May: Hosted a breakfast meeting at the 1995 NPT Review and Extension Conference in New York, " *Plutonium on the Loose? Implications of the World's Growing Plutonium Stockpiles,*" attended by over 30 NPT delegates.
- June: IEER President Arjun Makhijani traveled to DOE sites to promote vitrification as the best alternative for plutonium disposition. Visits included the Idaho National Engineering Lab in Idaho Falls, ID; cities in Colorado near the Rocky Flats Plant; and Amarillo, TX near the Pantex plant.

Grassroots Technical Support

- April: Radiation and Health Workshop in Wilmington, OH
- June: Radiation and Health Workshop in Washington, DC
- September: Completed 6-part video series highlighting information from these workshops

Release of Major Publications and Articles

- May/June: Arjun Makhijani's article "'Always' the Target?" appears in the *Bulletin of Atomic Scientists*. (See SDA Vol. 4 No. 3 for a summary)
- July: IEER releases *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and its Health and Environmental Effects* (MIT Press 1995). The book was produced jointly with IPPNW, has 17 authors and was edited by Arjun Makhijani, Howard Hu and Katherine Yih. See page 7 for ordering information.
- October: IEER releases *Mending the Ozone Hole: Science, Technology and Policy* (MIT Press, 1995). Co-written by Arjun Makhijani and IEER Senior Scientist, Kevin Gurney. See page 7 for ordering information.
- December: IEER will release a Russian version of *Fissile Materials in a Glass, Darkly,* its report on vitrification and plutonium disposition.

Projects in the Works

- *Reprocessing Confusion*, a report by Noah Sachs, is in the final review stage and will be released soon. The report provides an in-depth analysis of DOE reprocessing policy.
- In early 1996 IEER will release *The Future of the Weapons Complex*, a report by Hisham Zerriffi evaluating the need for a new tritium source and the rationale and need for the Science Based Stockpile Stewardship Program. Zerriffi is also completing a 10-page report on tritium, examining the relationship between nuclear strategy, health and the budget.

Calculating Doses *from page 6*

room for legitimate debate about how future generations ought to be protected from what we do today, the lack of a clear resolution to the mathematical question is very troubling.

A first reading of the report led me to the conclusion that despite some differences of detail, the method in Appendix C had a close relationship to that described in a report by the Electric Power Research Institute (EPRI). The EPRI report, cited by Pigford in his dissent but not in Appendix C, shows calculations based on one variant of the probabilistic critical group method.[10] This variant is not in conformity with the ICRP critical group method and is not claimed to be.

I had assumed that the calculations by EPRI were an adequate description of possible results of actually trying out the suggested approach to risk evaluation. However, in a review of an early draft of this article, NAS committee chairman Fri explicitly denied the connection:

> . . . it is simply untrue to suggest that the approach in Appendix C derives from an EPRI report. If it is the report I think you may have in mind, any careful comparison of the calculations involved would quickly show no relationship.[11]

Yet, the committee does not seem to have done an extensive check of its own to prove that the

See **Calculating Doses** *page 13*

[10] Kessler, J.H. and R. L. Yang, *A Proposed Public Health and Safety Standard for Yucca Mountain: Presentation and Supporting Analysis*, EPRI TR-104012, Electric Power Research Institute, Palo Alto, CA, December 1994. An earlier version of this report, issued in April 1994, was presented to the committee prior to its drafting of its report.

[11] Robert Fri, fax message to Arjun Makhijani, October 11, 1995.

Calculating Doses *from page 12*

model is consistent with the ICRP. This is also surprising, since the method is, according to the committee itself, new and complex. IEER has asked for background technical information that the NAS committee, which held closed door technical sessions,[12] used in arriving at the conclusion that this method was workable and suitable for protecting public health. We will provide further analysis if and when the data are forthcoming.

Implications Beyond High-Level Waste Disposal

The abandonment of explicit groundwater protection, if adopted by the EPA for its Yucca Mountain standard, would set a dangerous precedent. Industry will likely begin to clamor for its extension to all radioactive waste disposal and to cleanup standards for the nuclear weapons complex and other contaminated areas. That could mean the abandonment of clean water standards for vast sections of the country. In the current anti-regulatory climate, it is not at all out of the question that the approach may be extended to cover all toxic materials.

The abandonment of explicit groundwater protection, if adopted by the EPA for its Yucca Mountain standard, would set a dangerous precedent.

To treat groundwater, and by implication all other water, as if it is not a common resource for humanity is a sad abandonment of basic principles of ecology and of environmental protection. Any extension of such a philosophy would negate a central ecological presumption of radiation protection: that all other forms of life would be protected if human health is protected. While one may assume technology will save humanity if we all earn our living as casino operators and defense workers, other living beings do not have the same options.

It is relevant to note here that Yucca Mountain is claimed by the Western Shoshone people as their land. The NAS committee chose to entirely ignore not only their claims, but also their customs and their idea of what is to be protected. The recommendation of the NAS committee, which ignores groundwater protection as an explicit goal, along with the majority's probabilistic critical group method could provide the first step along a disastrous road to the abandonment of protection of other living beings.

Here is how Corbin Harney, an elder and spiritual leader of the Western Shoshone people, sees life and environmental protection on that same land:

> We've been taught this from the beginning of our lives: *take care of this land and everything that's on it; take care of it well in order to bring good to all the plant life and all the things that are here.* We have to take care of them all.[13]

[12] *Las Vegas Sun*, April 28, 1994.
[13] Harney, Corbin, *The Way It is*, Blue Dolphin Publishing, Nevada City, CA, 1995; p. 8.

LETTERS

Thanks for sending the newsletter. It's very motivating to have scientific support like IEER-publications and reading them makes fun, a rare event in often stubborn long-term work for a nuclear free world.
— Dietrich Weber,
Gottingen, Germany

I write to express the Embassy's appreciation for your efforts to assist us with our recent inquiries into the environmental impact of US testing at some of its former test sites. Above all thank you for putting me in touch with Lois Chalmers. Her efforts, and kind patience, on our behalf were absolutely invaluable.
— Dell Higgie,
Counselor for His Excellency L.J. Wood
New Zealand Embassy
Washington, DC

It Pays to Increase Your Jargon Power

by Dr. Egghead

1. High-Level Waste

a. What the sanitation workers find on the curb the day after Christmas.
b. Waste produced by high-level government officials
c. Waste, which due to its high level of toxicity, has to be kept on high shelves out of reach of children.
d. Spent fuel and reprocessing waste.

2. Geologic Repository

a. Special Greek urn made out of materials extracted from a specific geologic region into which votes were cast.
b. In India, place of repose, located on a particular geological formation in the Himalayas where Brahmins like to meditate.
c. A geological repository is a system which is intended to be used for, or may be used for, the disposal of radioactive wastes in excavated geologic media. (10 CFR 60)

3. Spent Fuel

a. What remains after cow dung fuel has been burnt.
b. Fuel one can spend instead of money in a new cashless society.
c. Fuel which has been withdrawn from a nuclear reactor after irradiation. (10 CFR 60)

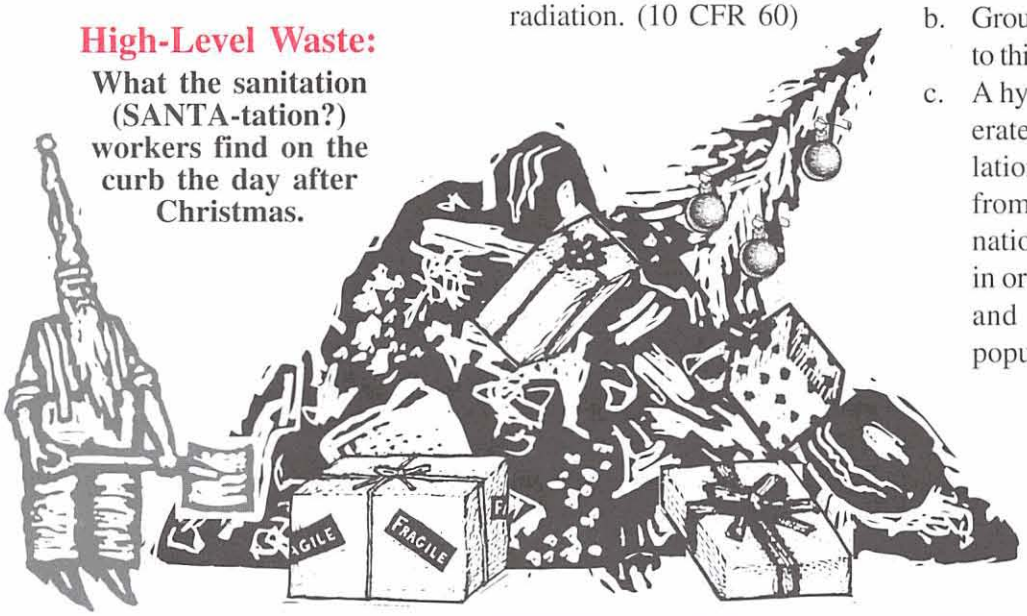
4. Critical Group

a. Members of a Paris café philosophical discourse group who criticized the regime of Louis the XIV (and everyone else).
b. In analogy with a critical mass, a group of people which, with the right number and ideology, could produce an explosive upheaval in society.
c. The group of individuals reasonably expected to receive the greatest exposure to radioactivity from a disposal or decommissioning activity.

5. Probabilistic Critical Group

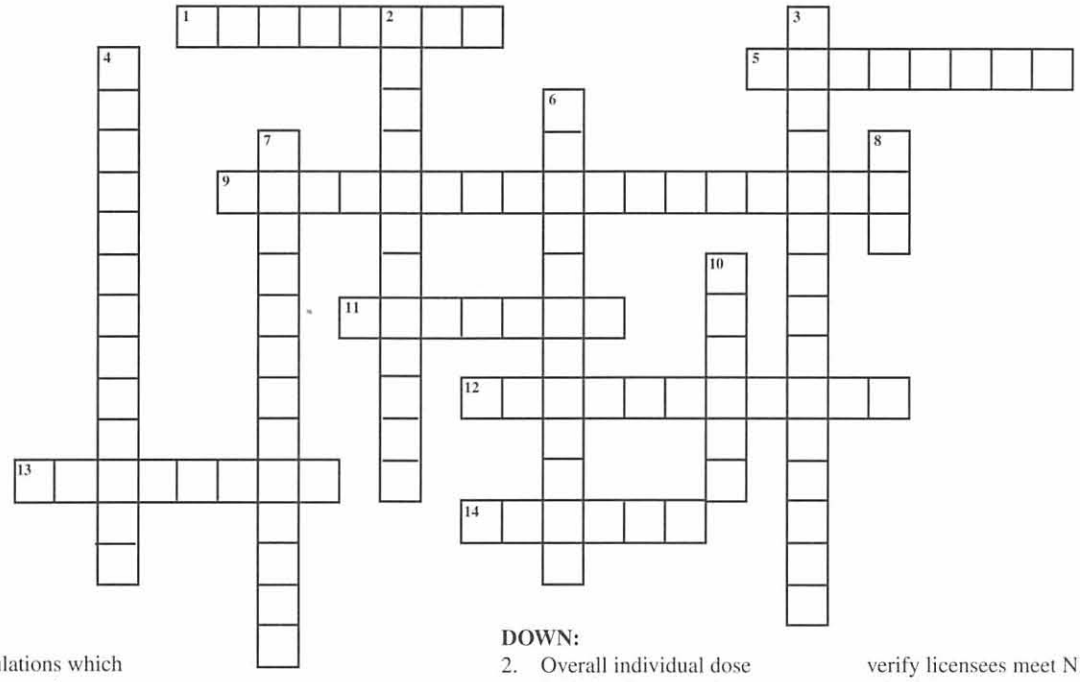
a. Groups of people who challenge the use of probability as being scientifically valid.
b. Groups of people whose ability to think critically is improbable.
c. A hypothetical population generated by "Monte Carlo simulations" that select randomly from environmental contamination and exposure scenarios in order to assess average dose and risk to a hypothetical population.

High-Level Waste:
What the sanitation (SANTA-tation?) workers find on the curb the day after Christmas.



Atomic Puzzler

Just when you thought you could give your mind a rest, it's the Atomic Puzzler— our popular **Crossword Edition.** Time to challenge your word power *and* your reading skills. *All words are described somewhere in this issue of the newsletter.* Good luck! And remember, **you could win $25!!**



ACROSS:

1. Federal regulations which codify current environmental radiation protection standards for high-level waste repositories.
5. System to be used for disposal of high-level radioactive wastes below ground: _____ Repository.
9. Occupation of hypothetical "maximally exposed individual" commonly used in constructing scenarios to calculate a future population's potential exposure to radiation.
11. Only member of the National Academy of Sciences panel to file a dissent to the majority findings.
12. Term describing possible ways a contaminated plume of groundwater might travel: Plume _____.
13. Native American tribe which claims the site described in 7 Down as their land: Western _____.
14. The regulatory law which requires the national oil and hazardous substances pollution contingency plan.

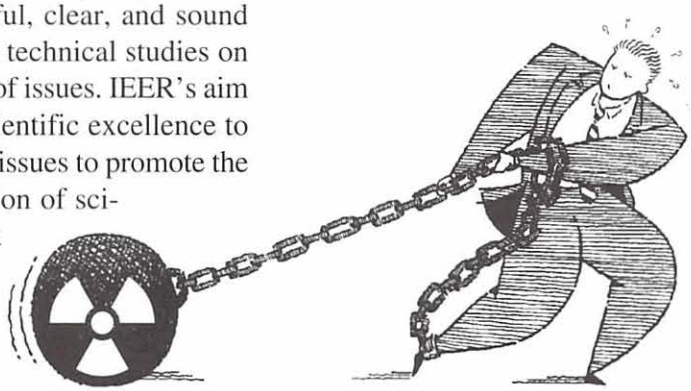
DOWN:

2. Overall individual dose limit for the general population from all sources of radiation other than medical.
3. Decontamination and dismantlement of retired, contaminated nuclear facilities and removal and/or disposal of the resulting wastes.
4. The individuals reasonably expected to receive the greatest exposure to radioactivity from a disposal or decommissioning activity.
6. Type of survey routinely conducted by the Nuclear Regulatory Commission to verify licensees meet NRC criteria.
7. Current U.S. law dictates that this location is the only potential repository to be investigated for disposal of high-level wastes in the United States.
8. Chairman of an *ad hoc* panel of the National Academy of Sciences which studied the setting of standards for high level waste disposal in the location referred to in 10 Down.
10. This state is home to the only potential repository for high-level nuclear wastes in the U.S.

The **Atomic Puzzler** is a regular *Science for Democratic Action* feature. We offer 25 prizes of $10 each to people who send in solutions to all parts of the puzzle, right or wrong. There is one $25 prize for a correct entry. Fill in the puzzle and submit the answer (either a photocopy of the solved puzzle or the answers written out) to Pat Ortmeyer, IEER, 6935 Laurel Avenue, Takoma Park, MD 20912. If more than 25 people enter and there is more than one correct entry, the winners will be chosen at random. The deadline for submission of entries is **January 31, 1996.**

Answers to the Last Atomic Puzzler (Vol. 4, No. 3) **Across:** 2. Twelvehundred; 4. Bequerel; 6. Fusion; 8. Roentgen; 9. Fission; 10. Manhattan Project; 11. Leslie Groves; 12. Gamma. **Down:** 1. Article six; 3. Joseph Rotblat; 5. Robert Oppenheimer; 7. Five

The Institute for Energy and Environmental Research (IEER) provides the public and policy-makers with thoughtful, clear, and sound scientific and technical studies on a wide range of issues. IEER's aim is to bring scientific excellence to public policy issues to promote the democratization of science and a healthier environment.



We gratefully acknowledge the generous support of the W. Alton Jones Foundation, Ploughshares Fund, the Unitarian Universalist Veatch Program at Shelter Rock, the John D. and Catherine T. MacArthur Foundation, Public Welfare Foundation, the Rockefeller Financial Services, the John Merck Fund and the C.S. Fund, whose funding has made possible our project to provide technical support to grassroots groups working on Department of Energy issues and our plutonium outreach project.

The Institute for Energy and Environmental Research
6935 Laurel Avenue
Takoma Park, MD 20912

NON-PROFIT
US POSTAGE
PAID
ROCKVILLE, MD
PERMIT #4297

Address correction requested.

In an effort to save  and  IEER is updating the *SDA* mailing list.

As of the next issue of *Science for Demoratic Action* (Vol. 5, No. 1), IEER will no longer be collecting subscription fees for the newsletter. *SDA* will still be sent out quarterly, but at no cost to the reader.

If you have had a change of address — or perhaps no longer wish to receive *SDA* — please tear out the postcard found in the center of this issue, fill in the proper information, and mail or fax it to IEER. If no changes are needed, just sit back and enjoy your current issue of *SDA*.

IEER PRESS

Printed on recycled paper.