federal register

Friday
December 15, 1989

Beth:
Thanks for your help.
The bit about the SAB
is on page 9 of the lot.
See you soon
Lance

Part II

Environmental Protection Agency

40 CFR Part 61
National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration

under Clean Air Act

GLORIA

HAPPY BIRTHDAY

FROM LOVE

Anna

THIS

IS

CARD

FOR

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 61

[FRL-3657-4]

RIN 2060-AC47

National Emission Standards for Hazardous Air Pollutants; Radionuclides

AGENCY: Environmental Protection Agency [EPA].

ACTION: Final rule and notice of reconsideration.

SUMMARY: This final rule announces the Administrator's final decisions on National Emission Standards for Hazardous Air Pollutants (NESHAPs) under section 112 of the Clean Air Act for emissions of radionuclides from the following source categories: DOE Facilities, Licensees of the Nuclear Regulatory Commission and Non-DOE Federal Facilities, Uranium Fuel Cycle Facilities, Elemental Phosphorus Plants, Coal-Fired Boilers, High-level Nuclear Waste Disposal Facilities, Phosphogypsum Stacks, Underground and Surface Uranium Mines, and the operation and disposal of Uranium Mill Tailings Piles. The final rule also responds to the major public comments on the March 7, 1989 proposed decisions for these categories (54 FR 9612). EPA is conducting this rulemaking pursuant to a voluntary remand and a schedule issued by the U.S. Court of Appeals for the D.C. Circuit which requires final action by October 31, 1989. In addition EPA is granting a reconsideration of the standards of 40 CFR part 61, subpart I concerning emissions from facilities licensed by the Nuclear Regulatory Commission, with respect to the issues of duplicative regulation and possible effects on medical treatment.

DATES: Effective Date: December 15, 1989. Subpart I is stayed until March 15, 1990. Comments on subpart I may be submitted on or before February 13, 1990. The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of December 15, 1989. Under section 307(b)(1) of the CAA, judicial review of decisions under section 112 is available only by filing a petition for review in the United States Court of Appeals for the District of Columbia Circuit within 60 days of today's publication of these rules. Under section 307(b)(2) of the CAA, the requirements that are the subject of today's notice may not be challenged later in civil or criminal proceedings brought by EPA to enforce these requirements.

ADDRESS: Comments on subpart I should be submitted (in duplicate if possible) to: Central Docket (A-130), Environmental Protection Agency, Attn: Docket No. A-79-11, Washington, DC 20460.

FOR FURTHER INFORMATION CONTACT: James M. Hardin, Environmental Standards Branch, Criteria and Standards Division (ANR-460), Office of Radiation Programs, Environmental Protection Agency, Washington DC 20460, (202) 475-9610.

SUPPLEMENTARY INFORMATION:

Motion for Reconsideration

For any party who wishes to present new information to EPA, regarding the appropriateness of these rules, a Petition for Reconsideration may be filed under section 307(d)(7)(B).

Docket

The rulemaking record is contained in Docket No. A-79-11 and contains information considered in determining health effects, listing radionuclides as hazardous air pollutants, and setting standards. It also contains all comments received from the public during the comment period. This docket is available for public inspection and copying between 8:00 a.m. and 3:00 p.m. on weekdays. A reasonable fee may be charged for copying.

A single copy of the Background Information Document and Economic Assessment (which, combined, form the final Environmental Impact Statement (EIS)) have been placed in the docket. Other documents available include: A Guide for Determining Compliance with the Clean Air Act Standards for Radionuclide Emissions from NRC-Licensed and Non-DOE Federal Facilities (October 1989); Procedures Approved for Demonstrating Compliance with 40 CFR part 61, subpart I (October 1989); and User's Guide for the COMPLY Code (October 1989). Copies of these documents may be obtained by writing to: Director, Criteria and Standards Division (ANR-460), Office of Radiation Programs, Environmental Protection Agency, Washington, DC 20460.

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I. Definitions

A. Terms

Activity—The amount of a radioactive material. It is a measure of the transformation rate of radioactive nuclei at a given time. The customary unit of activity, the curie, is 3.7×10^{10} nuclear transformations per second.

Agreement State—Any state with which the Nuclear Regulatory Commission or the former Atomic Energy Commission has entered into an effective agreement under subsection 274(b) of the Atomic Energy Act.

Annualized Cost—A stream of annual payments for a determined time period, equal in value to a one-time payment based on a selected rate of interest.

By-product Material—Any radioactive material (except source material and special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear

THE TORONTO STAR
Saturday,
October 12, 1991

WHEELS

Pages H1-H22

'Curbsiders' love to take you for a ride

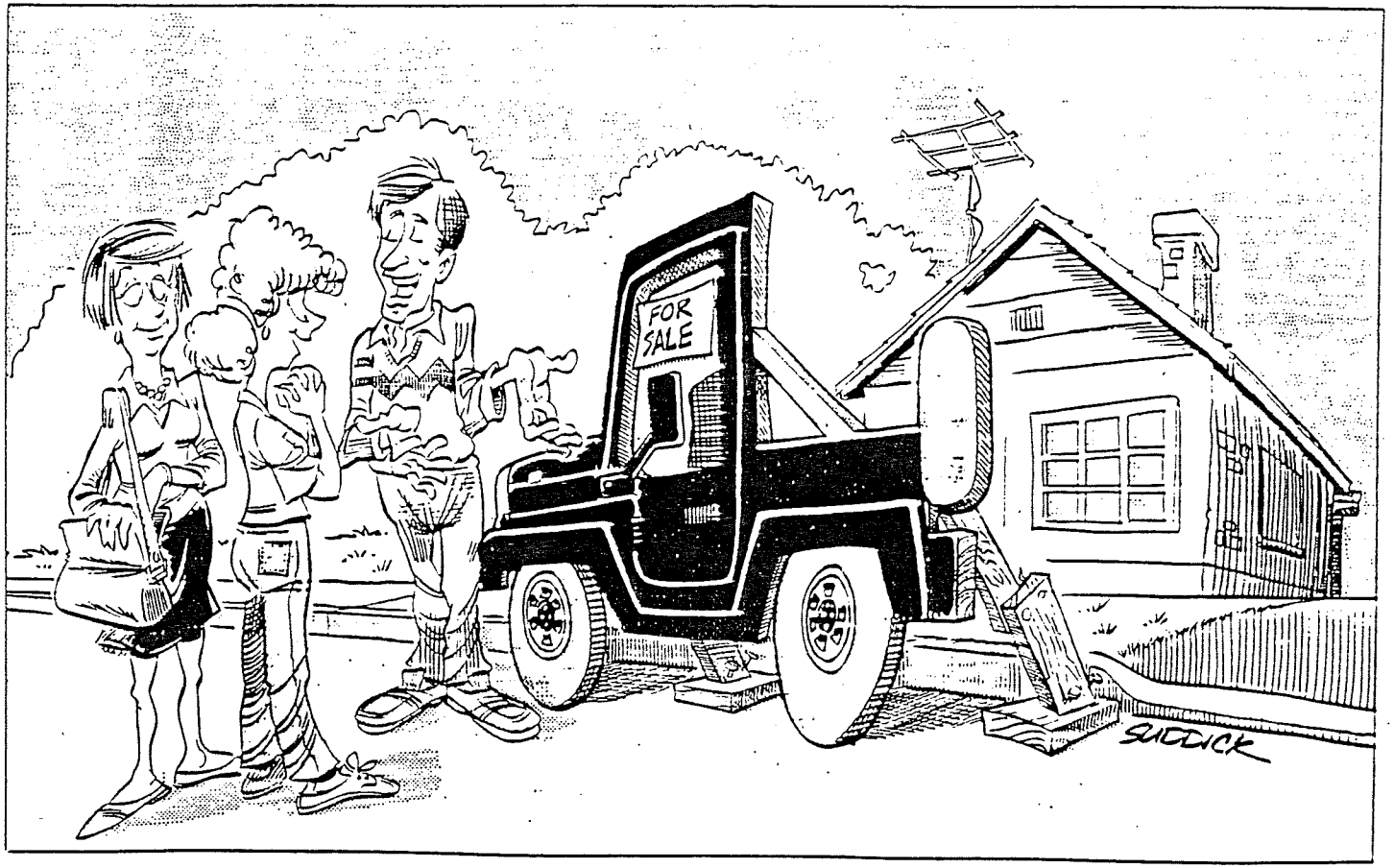

ILLUSTRATION BY BILL SUDDICK

FALSE FRONT: Curbsiders are convincing, as one family discovered when they were burned in a Jeep deal.

material and wastes from the processing of ores primarily to recover their source material content.

Dose Standard—A regulatory standard that requires a regulated facility to limit its emissions to the level necessary to ensure that no individual receives an effective dose equivalent greater than the specified level.

Effective Dose Equivalent (EDE)—The sum of the risk-weighted organ dose equivalent commitments. The effective dose equivalent has the same risk (for the model used to derive the weighting factors) as a uniform dose equivalent to all organs and tissues. For the purposes of these standards, "effective dose equivalent" means the result of the calculation used to determine the dose equivalent to the whole body, by taking into account the specific organs receiving radiation, the dose each organ receives, and the risk per unit dose to that organ. A description of the weighting factors used in the calculation of the EDE is described in detail in the International Commission on Radiological Protection's Publication No. 26, Pergamon Press, New York (1982).

Flux standard—A regulatory standard that limits the amount of radon that can emanate per square meter of regulated material per second, averaged over a single source.

Half-Life—The time in which half the atoms of a particular radioactive substance transform, or decay, to another nuclear form.

Incidence—This term denotes the predicted number of fatal cancers in a population from exposure to a pollutant. Other health effects (non-fatal cancers, genetic, and developmental) are noted separately.

Maximum Individual Risk—The maximum additional cancer risk of a person due to exposure to an emitted pollutant for a 70-year lifetime.

Pathway—A way that radionuclides might contaminate the environment or reach people, e.g. air, water, food.

Radionuclide—A type of atom which spontaneously undergoes radioactive decay.

Source Term—The amount of radioactive material emitted to the atmosphere from a source, either estimated, measured or reported, that is used in the risk assessment.

Transuranic—An element with an atomic number greater than the atomic number of uranium.

Uranium Fuel Cycle—The operations of milling of uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel, to the extent that these directly support the production of electrical power for public use utilizing nuclear energy. This definition does not include mining operations, operations at waste disposal sites, transportation of any radioactive material in support of these operations, or the reuse of recovered non-uranium special nuclear and by-product materials from the cycle.

B. Acronyms

AEA—Atomic Energy Act, 42 U.S.C. 2011 *et seq.*
ALARA—As low as reasonably achievable
AMC—American Mining Congress
ANPR—Advanced Notice of Proposed Rulemaking
CAA—The Clean Air Act, 42 U.S.C. 7401 *et seq.*
CAP-88—Clean Air Act Assessment Package-1988
CERCLA—Comprehensive Environmental Response Compensation and Liability Act, 42 U.S.C. 9601 *et seq.*
CFR—Code of Federal Regulations
BID—The Background Information Document prepared in support of this rulemaking (Volume 1 of the EIS)
EIA—The Economic Impact Assessment prepared in support of this rulemaking (Volume 2 of the EIS)
EIS—Environmental Impact Statement
DOE—United States Department of Energy
EDF—Environmental Defense Fund
EPA—United States Environmental Protection Agency
HLW—High-Level Radioactive Waste
ICRP—International Commission on Radiological Protection
MSHA—Mine Safety and Health Administration
mrem—millirem, 1×10^{-3} rem
NAAQS—National Ambient Air Quality Standards
NESHAP—National Emission Standard for Hazardous Air Pollutants
NCRP—National Council on Radiation Protection and Measurements
NRC—United States Nuclear Regulatory Commission
NRDC—Natural Resources Defense Council, Inc.
pCi—picocurie, 1×10^{-12} curie
UFC—Uranium Fuel Cycle
UMTRCA—Uranium Mill Tailings Radiation Control Act of 1978, 42 U.S.C. 7901, *et seq.*

II. EPA NESHAP's Policy

This section provides a description of the EPA's approach for the protection of public health under section 112. In protecting public health with an ample margin of safety under section 112, EPA strives to provide maximum feasible protection against risks to health from hazardous air pollutants by (1) protecting the greatest number of persons possible to an individual lifetime risk level no higher than approximately 1 in 1 million and (2) limiting to no higher than approximately 1 in 10 thousand the maximum estimated risk that a person living near a plant would have if he or she were exposed to the emitted pollutant for 70 years. Implementation of these goals is by means of a two-step standard-setting approach, with an analytical first step to determine an "acceptable risk" that considers all health information, including risk estimation uncertainty, and includes a presumptive limit on maximum individual lifetime risk (MIR) of approximately 1 in 10 thousand. A second step follows in which the actual standard is set at a level that provides "an ample margin of safety" in consideration of all health information, including the number of persons at risk levels higher than approximately 1 in 1 million, as well as other relevant factors including costs and economic impacts, technological feasibility, and other factors relevant to each particular decision. Applying this approach to the radionuclide source categories in today's notice results in controls that protect over 90 percent of the persons within 80 kilometers (km) of these sources at risk levels no higher than approximately 1 in 1 million.

A principle that accompanies these numerical goals is that the state of the art of risk assessment does not enable numerical risk estimates to be made with comparable confidence. Therefore, judgment must be used in deciding how numerical risk estimates are considered with respect to these goals. As discussed below, uncertainties arising from such factors as the lack of knowledge about the biology of cancer causation and gaps in data must be weighed along with other public health considerations. Many of the factors are not the same for different pollutants, or for different source categories.

A. Background

On March 7, 1989, EPA proposed decisions on standards under section 112 for twelve source categories of radionuclides. A principal aspect of the proposal, and the basis for the proposed decisions on the source categories, were four proposed approaches for decisions under section 112 as mandated by the D.C. Circuit's decision in *NRDC* v. *EPA*, 824 F.2d at 1146 (1987) (the *Vinyl Chloride* decision). The *Vinyl Chloride* decision required the Administrator to exercise his judgment under section 112 in two steps: first, a determination of a "safe" or "acceptable" level of risk

Section 7
The office of a director shall be vacated:

a) if he or she become bankrupt or suspends payment or compounds with his or her creditors or makes an authorized assignment or is declared insolvent;

b) if he or she becomes mentally incompetent;

c) if he or she ceases to have the necessary qualifications for office;

d) if he or she is absent without leave of the directors from three consecutive regular meetings of the directors;

e) if by notice in writing to the Co-operative he or she resigns his or her office;

f) if by resolution passed by a majority of the votes cast at a meeting of the members called for the purpose, her or she is removed from office;

or, in the case of the staff representative,

g) if by resolution passed by a majority of the votes cast at a meeting of staff called for the purpose, he or she is removed from office.

Section 8
Whenever any vacancy occurs on the Board of Directors the remaining members thereof, so long as there is a quorum in office, may fill a vacancy from among the persons having the necessary qualifications and the person so appointed shall hold office only until the next Annual General Meeting. **Should the elected staff representative resign during his or her term, the staff will hold an election and give formal written notification to the Board of the election results within two months of the resignation. If the staff fail to elect a replacement, the Board may appoint a qualified person from the general membership until the next annual general meeting.**

considering only health factors, followed by a second step to set a standard that provides an "ample margin of safety", in which costs, feasibility, and other relevant factors in addition to health may be considered.

The four proposed approaches were designed to provide for consideration of a variety of health risk measures and information in the first step analysis under the *Vinyl Chloride* decision—the determination of "acceptable risk." Included in the alternative approaches were three that consider only a single health risk measure in the first step: (1) Approach B, which considers only total cancer incidence with 1 case per year as the limit for acceptability; (2) Approach C, which considers only the maximum individual risk ("MIR") with a limit of 1 in 10 thousand for acceptability; and (3) Approach D, which considers only the maximum individual risk with 1 in 1 million as the limit. The fourth approach, Approach A, was a case-by-case approach that considers all health risk measures, the uncertainties associated with them, and other health information.

In the second step, setting an "ample margin of safety", each of the four approaches considers all health risk and other information, uncertainties associated with the health estimates, as well as costs, feasibility, and other factors which may be relevant in particular cases. The proposal solicited comment on each of the approaches for implementing the *Vinyl Chloride* decision. The Agency received many public comments on the approaches from citizen's groups, companies and industry trade groups, state and local governments, and individuals.

B. General NESHAP Policy Considerations

The purpose of this section is to discuss the appropriate criteria for determining an "acceptable risk" and an "ample margin of safety". In its determination, EPA will consider measures of health risk, and limitations and uncertainties of the risk estimation methods and basic data. A discussion of these factors follows. The framework adopted in this proceeding has already been selected in the Benzene NESHAP and will also become the policies for decisions on future NESHAPs but will not apply to other Agency programs or other sections of the Clean Air Act.

1. Selection of Approach

Based on the comments and the record developed in the rulemaking, EPA selected an approach announced in the notice on benzene standards published on September 14, 1989 (54 FR 38044), based on Approaches A and C but also incorporating consideration of incidence from Approach B and consideration of health protection for the general population on the order of 1 in 1 million from Approach D. Thus, in the first step of the *Vinyl Chloride* inquiry, EPA will consider the extent of the estimated risk were an individual exposed to the maximum level of a pollutant for a lifetime. The EPA will generally presume that if the risk to that individual is no higher than approximately 1 in 10 thousand, that risk level is considered acceptable and EPA then considers the other health and risk factors to complete an overall judgment on acceptability. The presumptive level provides a benchmark for judging the acceptability of maximum individual risk, but does not constitute a rigid line for making that determination.

The Agency recognizes that consideration of maximum individual risk—the maximum estimated risk of contracting cancer following a lifetime of exposure to the emitted pollutant—must take into account the strengths and weaknesses of this measure of risk. It is estimated based on the assumption of continuous exposure for 24 hours per day for 70 years. As such, it does not necessarily reflect the true risk, but displays a conservative risk level which is an upperbound that is unlikely to be exceeded. The Administrator believes that an MIR of approximately 1 in 10 thousand should ordinarily be the upper end of the range of acceptability. As risks increase above this benchmark, they become presumptively less acceptable under section 112. They then would be weighed with the other health risk measures and information in making an overall judgment on acceptability. Or, the Agency may find, in a particular case, that a risk that includes MIR less than the presumptively acceptable level is unacceptable in the light of other health risk factors.

In establishing a presumption for MIR, rather than a rigid line for acceptability, the Agency intends to weigh it with a series of other health measures and factors. These include the overall incidence of cancer or other serious health effects within the exposed population, the numbers of persons exposed within each individual lifetime risk range and associated incidence within a radius around facilities, the science policy assumptions and estimation uncertainties associated with the risk measures, weight of the scientific evidence for human health effects, and other quantified or unquantified health effects.

The EPA also considers incidence to be an important measure of the health risk to the exposed population. Incidence measures the extent of health risk to the exposed population as a whole, by providing an estimate of the occurrence of cancer or other serious health effects in the exposed population. The EPA believes that even if the MIR is low, the overall risk may be unacceptable if significant numbers of persons are exposed to a hazardous air pollutant, resulting in a significant estimated incidence. Consideration of this factor would not be reduced to a specific limit or range, such as the 1 case per year limit included in proposed Approach B, but estimated incidence would be weighed along with other health risk information in judging acceptability.

The limitation of MIR and incidence are put into perspective by considering how these risks are distributed within the exposed population. This information includes both individual risk, including the number of persons exposed within each risk range, as well as the incidence associated with the persons exposed within each risk range. In this manner, the distribution provides an array of information on individual risk and incidence for the exposed population.

Particular attention will also be accorded to the weight of evidence presented in the risk assessment of potential human carcinogenicity or other health effects of a pollutant. While the same numerical risk may be estimated for an exposure to a pollutant judged to be a known human carcinogen, and to a pollutant considered a possible human carcinogen based on limited animal test data, the same weight cannot be accorded to both estimates. In considering the potential public health effects of the two pollutants, the Agency's judgment on acceptability, including the MIR, will be influenced by the greater weight of evidence for the known human carcinogen.

In the *Vinyl Chloride* decision, the Administrator is directed to determine a "safe" or "acceptable" risk level, based on a judgment of "what risks are acceptable in the world in which we live." 824 F.2d at 1165. To aid in this inquiry, the Agency compiled and presented a "Survey of Societal Risk" in its March 1989 proposal (54 FR 9621–22). As described there, the survey developed information to place risk estimates in perspective and to provide background and context for the Administrator's judgment on the acceptability of risks "in the world in which we live." Individual risk levels in

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good

the survey ranged from 10^{-1} to 10^{-7} (that is, the lifetime risk of premature death ranged from 1 in 10 to 1 in 10 million), and incidence levels ranged from less than 1 case per year to estimates as high as 5,000 to 20,000 cases/year. Everyday risks include risks from natural background radiation as well as risks from home accidents. Natural background radiation (excluding radon) at sea level creates individual lifetime cancer risks in the range of 3 in 1,000 and an estimated 10,000 cancer cases per year. Naturally occurring radon in homes poses an additional source of radiation risk, and these risks can be as high as 1 in 100 to 1 in 10. EPA estimates that this causes an estimated 8,000 to 40,000 cancer cases per year. In the U.S., accidents, natural disasters, and rare diseases pose individual risks of death from 1 in 10,000 (e.g., tripping and falling which cause approximately 470 deaths per year) to 1 in 10,000,000 (e.g., rabies, which causes an average of 1.5 deaths per year).

Judgments on risks have also spanned a broad range of risk levels. The NCRP, following recommendations of the International Commission on Radiological Protection, has recommended that maximum individual exposures from non-medical, manmade radiation be limited to an amount corresponding to risks of 3 in 1,000. It is important to note that the recommendations of national and international bodies are coupled with recommendations that radiation doses should be "as low as reasonably achievable" (ALARA). The implementation of ALARA requires a site-specific consideration of the cost effectiveness of controls that could be added to reduce radiation doses.

The EPA concluded from the survey that no specific factor in isolation could be identified as defining acceptability under all circumstances, and that the acceptability of a risk depends on consideration of a variety of factors and conditions. However, the presumptive level established for MIR of approximately 1 in 10 thousand is within the range for individual risk in the survey, and provides health protection at a level lower than many other risks common "in the world in which we live." And, this presumptive level also comports with many previous health risk decisions by EPA premised on controlling maximum individual risks to approximately 1 in 10 thousand and below.

In today's decisions, EPA is using this approach based on the judgment that the first step judgment on acceptability cannot be reduced to any single factor. The EPA believes that the level of the MIR, the distribution of risks in the exposed population, incidence, the science policy assumptions and uncertainties associated with the risk measures, and the weight of evidence that a pollutant is harmful to health are all important factors to be considered in the acceptability judgment. The EPA concluded that this approach best incorporates all vital health information and enables the Agency to weigh it appropriately in making a judgment. In contrast, the single measure Approaches B, C, and D, while providing simple decisionmaking criteria, provide an incomplete set of health information for decisions under section 112. The Administrator believes that the acceptability of risk under section 112 is best judged on the basis of a broad set of health risk measures and information. As applied in practice, the EPA's approach is more protective of public health than any single factor approach. In the case of the radionuclide sources regulated here, more than 90 percent of the population living within 80 km would be exposed to risks no greater than approximately 1 in 1 million and, the total number of cases of death or disease estimated to result would be kept low.

Under the two-step process specified in the *Vinyl Chloride* decision, the second step determines an "ample margin of safety," the level at which the standard is set. This is the important step of the standard-setting process at which the actual level of public health protection is established. The first step consideration of acceptability is only a starting point for the analysis, in which a ceiling for the ultimate standard is set. The standard set at the second step is the legally enforceable limit that must be met by a regulated facility.

Even though the risks judged "acceptable" by EPA in the first step of the *Vinyl Chloride* inquiry are already low, the second step of the inquiry, determining an "ample margin of safety," again includes consideration of all of the health factors, and whether to reduce the risks even further. In the second step, EPA strives to provide protection to the greatest number of persons possible to an individual lifetime risk level no higher than approximately 1 in 1 million. In the ample margin decision, the Agency again considers all of the health risk and other health information considered in the first step. Beyond that information, additional factors relating to the appropriate level of control will also be considered, including costs and economic impacts of controls, technological feasibility, uncertainties, and any other relevant factors. After considering all of these factors, the Agency will establish the standard at a level that provides an ample margin of safety to protect the public health, as required by section 112. The Agency terms its approach the "multifactor approach."

2. Format of Standards

The format of the standards for the various source categories varies because of the differing properties of the sources and the radionuclides they emit. Area sources emitting radon are best monitored by flux measurements. Thus, flux standards are most appropriate. For other categories, mixtures of radionuclides are best related to public health through the use of the concept of dose. EPA has promulgated dose standards to limit emissions in those cases where it is appropriate. Where a single radionuclide is emitted or a single radionuclide emission limit would serve to limit all others, EPA has promulgated an emission limit for that radionuclide. All standards include releases from accidents and accidental releases can result in a violation of the standard. However, releases from accidents shall not be considered when determining whether or not a facility should be granted permission to construct or modify under §§ 61.07 and 61.08. Releases that are not routine but are more likely than not to occur are included in determining whether such approval shall be granted.

Plants are required to monitor their operations continuously and keep records of the results of their monitoring onsite for five years. Plant owners will have to certify on a semiannual basis that no changes in operations that would require new testing have occurred. Although the report is based on a calendar year, the emission limit applies to any year, i.e. any period of 12 consecutive months.

III. Historical Background of Radionuclide NESHAPs

On December 27, 1979, EPA listed radionuclides as a hazardous air pollutant under section 112 of the CAA (44 FR 76738, December 27, 1979). EPA determined that radionuclides are a known cause of cancer and genetic damage and that radionuclides cause or contribute to air pollution that may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, and therefore constitute a hazardous air pollutant within the meaning of section 112(a)(1).

UCC SUMMER CAMPS • 200 Lonsdale Road • Toronto, Ontario • M4V 1W6

Mr. & Mrs. Tony Easty
95 Hilton Ave.
Toronto, Ont
M5R 3E8

September 26, 1994

Dear Parent(s):

In our efforts to constantly improve the program, staffing and the facilities at UCC Camps, we are sending you this questionnaire to invite your comments about the 1994 Summer Camps.

Please show it to your children, and notice that certain sections invite comments from both you and your children, while other sections ask for comments from only you.

If you would be kind enough to take the time to fill in this questionnaire, we will read and pay close attention to your comments. Your input will help us to learn not only how UCC Camps excel, but also where we can improve.

Could you please return the questionnaire **as soon as possible**, as we are anxious to plan for next year using your input.

Thank you very much for taking the time to help your camp.

Yours truly,

Kelly Harris
Director of Summer Camps

P.S. We will be mailing out receipts documenting your transactions with the 1994 Summer Camps towards the end of October.

EPA then determined that radionuclides presented a risk warranting regulation under Section 112, and listed the pollutant under that section. Once listed, radionuclides became subject to the requirement of section 112(b)(1)(B) that EPA establish National Emission Standards for Hazardous Air Pollutants (NESHAPs) at a "level which (in the judgment of the Administrator) provides an ample margin of safety to protect the public health from such hazardous air pollutant," or find that they are not hazardous and delist them.

On April 6, 1983, EPA proposed standards regulating radionuclide emissions from four source categories: (1) Elemental phosphorus plants, (2) DOE facilities, (3) NRC-licensed facilities and non-DOE federal facilities (NRC-licensees), and (4) underground uranium mines. The Agency simultaneously proposed decisions not to regulate several other categories: (1) Coal-fired boilers, (2) the phosphate industry, (3) other extraction industries, (4) uranium fuel cycle facilities, (5) uranium mill tailings, (6) high level radioactive waste facilities, and (7) low energy accelerators (48 FR 15076, April 6, 1983). In February 1984, the Sierra Club filed suit in the U.S. District Court for the Northern District of California to compel EPA to take final action on the proposed standards. *Sierra Club* v. *Ruckelshaus*, No. 84-0658. EPA was subsequently ordered by the Court to promulgate final standards or make a finding that radionuclides are not hazardous air pollutants and delist them.

In October 1984, EPA withdrew the proposed emission standards for elemental phosphorus plants, DOE facilities, and NRC licensees, finding that the control practices already in effect for those categories protected the public from exposure to radionuclides with an ample margin of safety. EPA, therefore, concluded that no additional requirements were necessary (49 FR 43906, October 31, 1984). In the notice, EPA also withdrew proposed standards for underground uranium mines but stated its intention to promulgate a different standard for that category and simultaneously published an Advance Notice of Proposed Rulemaking (ANPR) for radon-222 emissions from underground uranium mines to solicit additional information on control methods. EPA also published an ANPR for radon-222 emissions from licensed uranium mills. EPA affirmed its decision not to regulate the other categories: coal-fired boilers, the phosphate industry, other extraction industries, uranium fuel cycle facilities, and high level radioactive waste. The Agency also decided to study further the category of phosphogypsum stacks to determine the need for a standard.

On December 11, 1984, the U.S. District Court for the Northern District of California found EPA in contempt of its order to promulgate final standards and again directed that EPA issue final radionuclide emission standards for the original four categories or make a finding that radionuclides are not hazardous air pollutants. EPA complied with the court order by promulgating standards for radionuclides emissions from elemental phosphorus plants, DOE facilities, and NRC-licensees (50 FR 7280, February 6, 1985) and a work practice standard for radon-222 emissions from underground uranium mines (50 FR 15385, April 17, 1985). On September 24, 1986, EPA promulgated a final rule regulating radon-222 emissions from licensed uranium mill processing sites by establishing work practices for new tailings (51 FR 34056, September 24, 1986).

The Environmental Defense Fund (EDF), the Natural Resources Defense Council (NRDC), and the Sierra Club filed petitions for review of the October 1984 withdrawals and final decisions not to regulate, the February 1985 standards for the three source categories and the April 1985 standard for underground uranium mines. The April 1985 standard for underground uranium mines was also challenged by the American Mining Congress (AMC). In November 1986, AMC and EDF filed petitions challenging the standard for licensed uranium mill processing sites.

On July 28, 1987, the U.S. Court of Appeals for the D.C. Circuit remanded to the Agency an emissions standard for vinyl chloride which had also been promulgated under Section 112 of the CAA. *Natural Resources Defense Council, Inc.* v. *EPA*, 824 F.2d 1146 (D.C. Cir. 1987) (*Vinyl Chloride*). The Court in *Vinyl Chloride* concluded that the Agency improperly considered cost and technological feasibility without first making a determination based exclusively on risk to health.

In light of that decision, EPA concluded that the standards for elemental phosphorus plants, DOE facilities, NRC-licensees, and underground uranium mines should be reconsidered and on November 16, 1987, moved the D.C. Circuit Court for a voluntary remand of the challenged decisions. EPA also agreed to reexamine all issues raised by the parties to the litigation. On December 8, 1987, the Court granted EPA's motion for voluntary remand and established a time schedule for EPA to propose regulatory decisions for all radionuclide source categories within 180 days and finalize them within 360 days. On March 17, 1988, the Court granted a subsequent EPA motion and modified the order to require proposed regulatory decisions by February 28, 1989 and final action by August 31, 1989.

On April 1, 1988, EPA also requested a remand for its standard for licensed uranium mill tailings. On August 3, 1988 the Court granted EPA's motion and put the uranium mill tailings NESHAP on the same schedule as the other radionuclide NESHAPs.

On March 7, 1989, EPA published a proposed NESHAP which described four possible policy approaches for regulating emissions of radionuclides. Public hearings were held on April 10, 11, 13, and 14, 1989.

On July 14, 1989, the court granted EPA's request for an extension until October 31, 1989 for final action.

IV. Characterization of the Risks of Radiation

A. Sources of Radiation

Every day each person is exposed to radiation from a variety of natural and manmade sources. Natural sources of radiation include cosmic rays, radon, and other terrestrial sources. Manmade radiation includes medical and dental X-rays, fallout from above ground nuclear weapons testing and industrial sources.

The earth's atmosphere acts as a shield to cosmic rays, absorbing much of the radiation. People receive a higher dose of cosmic rays at higher altitudes because there is less atmosphere to shield them from cosmic rays. For example, people living in the mountains receive a higher dose than people living at sea level, and people are exposed to even higher levels when flying in an airplane. Terrestrial radiation comes from the small amount of radionuclides that are naturally present in all matter: soil, air, food, clothes, and even our bodies.

Radon is a radionuclide that is produced as a radioactive decay product of the radium which is naturally found in soil. Radon is always present in the ambient air at levels which are estimated to pose some health risk. In addition, radon often gets trapped in homes, leading to even higher estimated health risks. EPA has issued recommendations to homeowners for reducing these risks.

This rulemaking deals with sources of radionuclide emissions, including radon, from industrial sources. Although the amount of radiation dose that most

GALA ENVIRONMENTAL FUNDRAISER

starring BOB BOSSIN

graduate of Innis College,
Moss Scholar
and, dare we say it, "artsie" member
of the LGMB.

singer, songwriter, storyteller and environmentalist. Founder of the legendary Canadian folk group Stringband. Creator of the musical Bossin's Home Remedy for Nuclear War - 200 performances, 9000 bottles of medicine sold!

with songs from his latest release Gabriola V0R 1X0
stories, slides, wit and the "Sulphur Passage" video.

Innis College Town Hall/University of Toronto.
Accessible space.

On Sunday, October 23rd, 1994,
at 3:30 in the afternoon.

Reception to follow: by request and donation.
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Adults $13.; Kids by donation. Donation or trade if you can't afford it.

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"It's so good" - Roz Larman KPPK radio ≈ "Not many people in the world can write songs that are funny, informative and inspiring at the same time. Bossin can." - Pete Seeger≈ "Bravo! Bravo! Bravo!" - Dinah Christie ≈ "Wonderful...wit, passion, and insight" - Joe Blake, Victoria Times Colonist ≈ "Bossin's best yet!" - Tom Paxton ≈ "Bob Bossin has the ear of a poet, a painter's eye and the wit of a of a true common sense philosopher"- Utah Phillips ≈ "Joyous, rollicking, pointed, sly and passionate" - Ken Orchard, Offbeat Magazine ≈ "Brilliant.....The Clint Eastwood of Canadian folk music.Bob still shoots straight and true." - Gary Cristall, Vancouver Folk Music Festival ≈ "It deserves to sell a million (but probably won't)." - Leon Rosselson ≈ Bob Bossin is among the quirkiest, most unpredictable, funniest and most respected of Canada's folk composers." - Verne McDonald, the Georgia Straight ≈ "A serious painterly muse with lopsided comic relief....when it works, it really works" Greg Potter, Toronto Star ≈ "Wonderful and catchy" - Folkprints ≈ "The songs show a life being lived with both eyes open" - Margaret Isaacs, Weekender, CBC Stereo ≈ "Wonderful songs that linger in people's memories" - Peter Gzowski, Morningside ≈ "Fine musicianship and songwriting....in the best tradition of feminist music" - Bob Franke ≈ "A wonderful album...hopelessly unmarketable." - Richard Flohill.

people receive as a result of these emissions is typically lower than their natural background dose, the resulting risk can still be significant. A source does not present an acceptable risk simply by being less than natural background. It is important to note that total background radiation from all sources, including naturally occurring radon, results in a calculated individual lifetime risk of fatal cancer of approximately one in one hundred. In most cases, little can be done to reduce most of this radiation exposure which people receive from natural background.

Industrial sources of radionuclide emissions in the air include a wide variety of facilities, ranging from nuclear power facilities to hospitals to uranium mill tailing piles. Industry uses hundreds of different radionuclides in solid, liquid, and gaseous forms, emitting different types of radiation (alpha, beta, gamma) at various energy levels. Industrial sources of radionuclide emissions fall into two major categories. The first include industries that use radioactive materials and have emissions as a result of an inability to completely contain the materials they use. For example, hospitals use radionuclides as part of their radiology departments. Since many of the radionuclides they use are gases, liquids capable of evaporation, or solid capable of sublimation, some radionuclides inevitably are released into the environment. The other type of source is that which releases radionuclides (usually radon) as an unintended consequence of another activity, such as mining or milling. An example of this is phosphogypsum stacks (piles). These piles of waste material emit radon because radium (from which radon is produced by radioactive decay) is found naturally in the same soils that are the source of phosphate rock.

B. Health Effects of Radiation

The level and type of hazard posed by radionuclides vary, depending on such characteristics as the radionuclide's radioactive half-life, the type of radiation it emits, the energy level of the emission(s), and its ability to concentrate in the body. Different radionuclides will irradiate different parts of the body causing different types of cancers.

There are three major types of long-term health impacts from exposure to radiation: Cancer, hereditary effects, and developmental effects on fetuses such as mental retardation. Since there is such a strong foundation for quantifying the risk of fatal cancer, EPA's consideration of fatal cancers is the principal health consideration in this rulemaking. However, it is important to note that other health effects have also been considered in the rulemaking. The other effects are not specifically addressed in this discussion because none of them pose a more severe risk to health. In addition, risk distribution of health effects from radiation from most of the sources considered for regulation show that fatal cancers occur much more frequently than non-fatal cancers and cancers generally occur more often than genetic or developmental effects. For sources that emit radon, no genetic or developmental effects, and very few non-fatal cancers are expected.

Numerous studies have demonstrated that radiation is a carcinogen. It is assumed that there is no completely risk-free level of exposure to radiation to cause cancer. Health effects from radiation have been observed in studies of occupationally exposed workers and of the survivors of the Hiroshima and Nagasaki atomic bombs. This information has been verified with studies of animals in laboratories. However, the effects of radiation doses at low levels of exposure can only be predicted by extrapolating from the observed effects at higher doses since we do not have direct evidence of cancer causation at low exposure levels. Some pollutants cause diseases that are unique to the pollutant; for example, asbestos causes asbestosis. Radiation, however, causes some of the same types of cancers, e.g. leukemia and lung and liver cancer, that are caused by other factors. Since these cancers are not uniquely associated with radiation, it is not possible to differentiate cancers caused by radiation from other cancers.

The second type of effect is the induction of hereditary effects in descendants of exposed persons, which vary in degree and effect and may even be fatal. It is assumed that there is no completely risk-free level of exposure for hereditary effects. Although hereditary effects have been observed in experimental animals at high doses, they have not been confirmed at low doses in studies of humans.

Based on extensive scientific evidence, EPA believes it prudent to assume that carcinogens, including radionuclides, pose a risk of health effects even at low levels of exposure. Based on this science policy judgment, EPA calculates health risk estimates assuming that the risk of incurring either cancer or hereditary effects is linearly proportional to the dose received in the relevant tissue. However, the severity of either effect is not related to the amount of dose received. That is, once a cancer or an hereditary effect has been induced, its severity is independent of the dose.

Regarding cancer, there continues to be divided opinion on how to interpolate between the absence of radiation effect at zero dose and the observed effects of radiation (mostly at high doses) in order to estimate the most probable effects at doses that represent small increases above natural background radiation. Most scientists believe that available data best support use of a linear model for estimating such effects. Others, however, believe that other models, which usually predict somewhat lower risk, provide better estimates. These differences of opinion have not been resolved to date by studies of the effects of radiation in humans, the most important of which are those of the survivors of the Hiroshima and Nagasaki atomic bombs.

Some studies have recently been completed, and others are now underway to reassess radiation dose calculations for the survivors of the Hiroshima and Nagasaki atomic bombs and to provide improved estimates of risk. These studies may reduce the uncertainty associated with extrapolation from high doses to low doses. These studies may also result in an increase of the estimated risk per unit dose. But they will not address the question of whether a threshold exists. EPA is monitoring the progress of this work and will initiate reviews of the risks of exposure to low levels of radiation upon its completion.

C. Risk Assessment

1. Risk Measures Considered in NESHAP Policy

In decisions on cancer risks from stationary sources of hazardous air pollutants, the Agency has estimated three measures of health risk. These are termed "maximum individual risk", "risk distribution", and "incidence". Each of these combines an estimate of the dose/response for a pollutant with estimates of exposure to the pollutant. The response estimated is the pollutant-related increase in the probability that an individual will contract fatal cancer in his or her lifetime. The exposure estimated is the average daily exposure assuming exposure for 70 years.

a. *Maximum Individual Risk.* Individual risk is expressed as an estimated probability, e.g., 1 in 100 (10^{-2}), 1 in 1,000 (10^{-3}), 1 in 10,000 (10^{-4}). Thus, a 1×10^{-3} individual risk is an added "chance" of 1 in 1,000 of contracting fatal cancer sometime in the individual's lifetime.

TORONTO BOARD OF EDUCATION

155 COLLEGE STREET
TORONTO, CANADA,
M5T 1P6
(416) 397-3000

October 21,1994

Dear Parents:

As you may be aware, on Thursday October 20, 1994 a very serious situation occurred at Brockton High School in which two of our teachers suffered gunshot wounds. Thankfully both are recovering. Police arrested a suspect almost immediately and he has been charged.

This is a tragic event for the students and staff at Brockton High School and for all of our schools. All Toronto Board schools have been asked to develop appropriate ways of helping students and staff by providing opportunities for them to discuss concerns and express their feelings over the next few days. Our guidance staff, social workers and psychologists will be working to support them.

Please be assured that the Toronto Board is committed to ensuring that our schools are as safe as we can make them. Our new safety and security policy is being implemented throughout the Board. This policy is built on the principles of:

- mandatory response to incidents of violence
- continued commitment to prevention programs, and
- working in partnerships with students, parents and the wider community

One of our priorities is the establishment of Safe School Committees in each school which will be charged with conducting a safety and security audit and the development of a School Safety Plan. You can help us by becoming involved in your local school safety initiatives.

Sadly, acts of violence can occur anywhere and, yesterday, Brockton High School faced an enormously difficult situation. I am proud of the way the staff and students worked to respond so well to this tragic event.

Sincerely,

Joan M. Green

Joan M. Green
Director of Education

In this discussion, the maximum individual lifetime risk is the maximum additional cancer risk of any person due to exposure to an emitted pollutant for a 70-year lifetime. The maximum individual risk is sometimes called the maximum exposed individual risk. This estimate is based on the fact that the concentration of an emission, and the consequent risk, diminishes with distance from its source. For radionuclide NESHAP decisions, the practice has been to estimate exposure according to census data on residence locations. It has also been estimated in some other Agency decisions as the maximum at the source perimeter.

The maximum individual lifetime risk is different from average individual risk which is sometimes estimated for sources like public drinking water systems or food in which the concentration of a pollutant and other factors are assumed to be equal at all distribution locations. This distinction is particularly relevant when considering the maximum risk one might find acceptable from different sources. In using the maximum individual risk in acceptable risk decisions for hazardous air pollutants, its limitations should be considered. Used alone, the measure does not tell how many people may be so affected; it relates only to the risk to the most exposed individual(s).

b. *Risk Distribution.* A risk distribution estimates how many persons within a certain distance (e.g. 50 km) of a source of pollutant emissions are at what level of individual risk. Typically, the distribution is given for 10-fold increments of individual risk. Such a distribution provides the decisionmaker with information on both the individual risk level for those exposed and the number of persons exposed at each level. For NESHAP and other decisions, the Agency has examined risk distributions both as measures of risk and to compare the effects of various strategies for risk reductions across a source category.

In making an acceptable risk decision, one relevant consideration is how many people are exposed at each risk level, e.g. a 10^{-4} risk might be acceptable if only one person were at that level, but not if 1 000 people were subject to it. Similarly, the numbers of persons exposed at various individual risk levels could be an important element in deciding on acceptable risk. The risk distribution could be used in similar ways to consider whether an ample margin of safety exists.

c. *Incidence.* Incidence is an estimate of population, rather than individual, risk. It is derived by multiplying individual risk by the estimate of the number of persons at that level of risk and summing the results over all risk levels. This number, which provides a lifetime population risk figure, is then divided by 70 (years) to give an annual fatal cancer incidence estimate. The incidence parameter can be used as an estimate of impact on the entire exposed population within a given area by totalling the incidence associated with each increment of individual risk. Incidence can also be portrayed along with individual risk and population numbers in a risk distribution. Typically, the Agency weighs incidence estimates in conjunction with maximum individual risk or average individual risk estimates. Estimated incidence generally is a particularly informative parameter when looking at aggregate risk from a category of like sources. One feature to take into account whenever it is used is its dependence on the size of the source category.

2. Uncertainties in Risk Measures

Each of the three risk parameters defined above has three elements. These are the estimated response per unit of pollutant concentration (e.g. pCi/l in air), the estimated exposure concentration, and the estimation of the number and location of the population residing in the area of the sources (usually taken from census data).

Uncertainties exist in estimating each of these elements for a variety of reasons including the fact that the relevant data and our understanding of the biological events involved are not complete. Where data gaps exist, qualitative and quantitative assumptions are made based on our present understanding of the biological mechanisms of cancer causation, estimates of air dispersion, engineering estimates, and other factors. Selection of certain assumptions to be used is a policy decision. The Agency has published guidelines covering many of these for both cancer risk assessment and exposure assessment ("Final Guidelines for Carcinogen Risk Assessment," (51 FR 33992, September 24, 1986) and "Final Guidelines for Estimating Exposures," (51 FR 33042, September 24, 1986)).

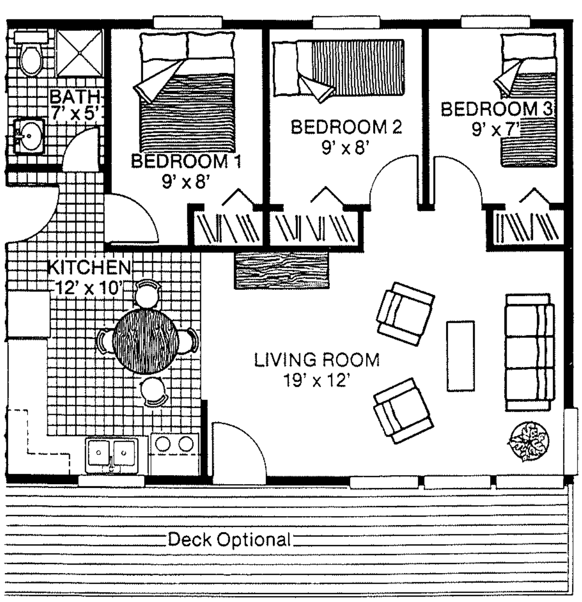
The following is a discussion of methods used to calculate the three parameters, together with a few examples of the uncertainties.

Risk assessment, under EPA guidelines, takes into account the nature and amount of evidence that the agent will cause the effect of concern in humans as well as the uncertainties of interpretation of data and its quantification. When the toxicity data from human studies are available, as in the case of radionuclides (which is a known human carcinogen), there is less uncertainty about the hazard of dose/response than when the data is solely from animal studies. Nevertheless, important uncertainties enter into the analysis even when human data is available. Examples include the fact that human epidemiological studies are often retrospective and measure effects of exposure that occurred many years in the past. The level of exposure to the agent at that time usually must be estimated and cannot be verified. Also, in certain categories of human studies, the studies are often of workers exposed to the pollutant. Worker populations are not representative of the general population with respect to age or sex. Workers are also generally the healthier segment of the population. These factors can lead to over- or underestimation of risk.

When data from animal studies are used, uncertainties about exposure can be experimentally controlled, but other uncertainties arise. Many of these concern the extrapolation from data collected in animal tests to estimate effects on humans. The extrapolation has to try to account for many factors, such as the equivalent dose for humans and laboratory animals given the size differences and the potential differences in metabolism and excretion of a chemical pollutant.

In addition, uncertainties arise in extrapolating the observed dose/response relationship from either workplace or animal test exposures to the usually lower dose levels of the general population.

In estimating exposure, the dispersion of a pollutant from a source is usually quantified by a predictive mathematical model using a known or model source emission rate, temperature and velocity characteristics, and weather patterns at a nearby recording weather station. The model predicts the concentration of the dispersed pollutant at various distances from the source. Standard assumptions are that the population around the source resides there for a 70-year lifetime and is continuously exposed to the modeled concentrations. The amount of emissions can be derived from sampling and analysis of emissions at the source or from engineering estimates, with more or less uncertainty associated with each method according to the type of emission. There are varying degrees of accuracy and precision in sampling, analysis, or estimates of emissions. Therefore, the uncertainties involved in the method of estimating individual exposure and the number of individuals exposed are



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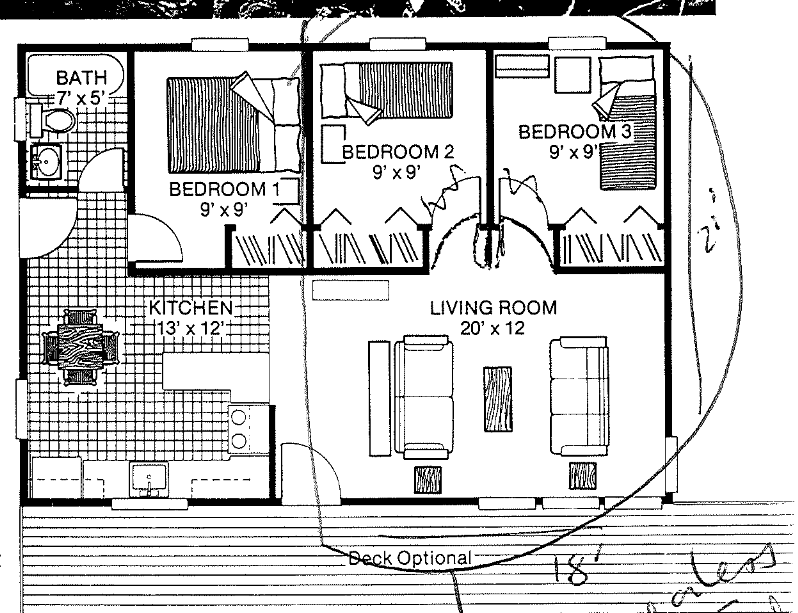

c

This is more or less what we want — Ratcliffe would charge $10-11,000 erected.

numerous. Thus, it is evident that uncertainty is difficult to quantify. However, the Agency has completed a preliminary uncertainty analysis of risk from radionuclide emissions from a limited number of facilities using Monte Carlo simulation techniques. Instead of discreet values, distributions were used for factors having a significant effect on outcome. The results suggest that the risks calculated represent essentially median values if the receptor remains a that location for 70 years.

3. Methodology

To take into account the buildup of radioactivity in the body and the environment, the risk assessment models incorporate the concepts of committed dose and the dose committed by an annual release into the environment or, equivalently, the annual dose received at equilibrium as a result of constant annual releases over long periods of time.

In attempting to make these estimates, EPA has tried at all times to give "best estimates" of the radionuclide concentrations in the environment and individual and population risks. Wherever possible, measured or reported data of emissions, meteorology and population were used. Where estimates were used, EPA has tried to use the most likely numbers in its assessments. When model facilities were used, they were designed to be representative of actual facilities. EPA's risk assessments are based on a current "snapshot" of each industrial source category as it now stands. EPA has not estimated the maximum conceivable risks that may result from the facilities analyzed at some point in the future. Future risks may be higher or lower depending on whether people move closer to, or further away from, the facilities studied and whether the emissions from those facilities increase or decrease. This is not to say that there is little or no uncertainty in the final results. As in all such assessments, the analyses have considerable uncertainty. EPA's analyses are not designed to consistently overestimate or underestimate risks.

The level of uncertainty is greater in the estimate of the maximum individual risk than in the estimate of population risk. Many possible errors in the analysis can cancel out in assessments of populations. For example, local meteorological conditions may cause more radionuclides to go in one direction than another. This effect may cause an overestimate or underestimate of the maximum individual risk, depending on where the most exposed individual is located. However, this source of error tends to be less important in population estimates, since the analysis integrates individual doses to a large number of people. If one person gets a larger risk due to local dispersion effects, it means that another person is getting less. Consequently, when the individual risks are summed, local conditions will not cause a serious error in the value for total population risk.

In estimating the radiation exposure to the most exposed individual, EPA assumes that the person receiving the maximum individual risk lives for a 70-year lifetime at the same site. EPA then makes its best estimate of the risks to that individual.

EPA recognizes that most people will not actually live their entire life in the same location. Nevertheless, EPA makes this assumption as a matter of policy and does not believe that it diminishes the validity of its risk assessments. EPA has made this assumption for several reasons: First, EPA is attempting to estimate the maximum individual risk, and it is completely possible that an individual could live in the same place for his or her entire life. Use of different assumptions could lead, in some cases, to underestimating the actual maximum risk.

Second, a large fraction of the risk can occur in less than the same fraction of the 70 years. Risk is not independent of age. Children appear to be more susceptible to the effects of radiation than adults. In addition, due to their youth, they generally have a longer time in which to develop the cancer caused by the radiation (and they are less likely to die of something else before they contract and die of the cancer). Due to these two factors, younger people are at a greater risk from the same dose than older people. (See Table 1). If EPA were to reduce the number of years of assumed exposure to less than a lifetime, it is unclear what number of years should be used or where to place those years within a lifetime. For example, should EPA assume that a person lives in the same place from birth to age 19 or from age 35 to 50? Generally, in the first case, the risk is 6 times greater than in the second case. Finally, the difference that would be caused by assuming a shorter period of exposure is not very significant. For an assumed constant rate of exposure, people receive over 60% of their total lifetime risk during their first nineteen years. To change the period of exposure from 70 years to the first 19 years of life would change the final result by less than a factor of 2.

Many commenters, including the SAB, disagreed with EPA's decision to use 70 year exposures in calculating maximum individual risk. However, as stated above, EPA believes that this is the correct method for doing risk assessments for NESHAPs. Had EPA used another method of calculating the maximum individual risk, it might have found it necessary to find a different, possibly more stringent benchmark for determining acceptable risk.

Third, the conservatism of this assumption counters two important and unknown uncertainties that can lead to an underestimation of risk. The first is the susceptibility of some members of the population to radiation. Scientific studies have shown that not all people respond in the same way to the same biological insult; some members of the population are more susceptible than the population as a whole. This problem is especially acute for the radon sources. Estimates of the risk of exposure to radon are largely based on epidemiological studies of miners, i.e. adult males. It is known that children seem to be more susceptible to radiation than adults. In addition, for some cancers, women are more susceptible than men; this may be true for lung cancer.

The second factor that EPA has been unable to quantify, but which would lead to an underestimation of the risk, is the synergistic effects of radiation with other pollutants. Radiation is not the only carcinogen in the environment. There are large numbers of carcinogens and potential carcinogens in the environment. Radionuclides are not the only carcinogens that cause cancer by first causing genetic damage. In addition, some chemicals may disrupt or stop the body's natural repair mechanisms. It is possible that some of these pollutants work synergistically with radiation to increase the effect of radiation above what it would be otherwise. While EPA's relative risk model takes into account the effect of chemicals that are widely distributed in the environment, there are hundreds of chemicals that are concentrated in local areas, and the effects of these chemicals are not and can not be taken into account. However, EPA's inability to quantify this potential increase in risk does not mean that this effect does not exist or that it should not be considered.

1990 READERSHIP SURVEY

Dear *University Affairs* Reader

University Affairs is conducting a cross-Canada survey of our readers. The purpose of this survey is to provide information that will help us to serve you better and to build a profile of our readership.

Your name was chosen randomly from our mailing list. The questionnaire should take you about 15 minutes to complete. We are enclosing a pre-paid return envelope for your convenience.

The questionnaire was designed by Optima Consultants in Applied Research Inc., an Ottawa-based research group. All of the returned questionnaires will be analyzed by Spectra Marketing, also an independent research company. The questionnaires are anonymous and the information you provide will be confidential.

Thank you for taking the time out of your busy schedule to complete this questionnaire.

Sincerely

Gloria Pierre

Gloria Pierre
Editor, *University Affairs*

TABLE 1— AGE DEPENDENCE OF RISK DUE TO WHOLE BODY RADIATION

Assumed Percentage of Total Lifetime Risk As A Function Of Ages At Which Radiation Exposure Occurs [1]

Period of exposure (ages)	Percentage of lifetime risk	Cumulative percentage of lifetime risk [1]
0 to 9	30	30
10 to 19	30	60
20 to 34	20	80
35 to 50	10	90
50+	10	100

[1] Exposure is at a constant rate for a lifetime.

4. Technology Availability and Plant Closure Considerations

In the benzene NESHAP, as well as in this NESHAP for radionuclides, EPA has considered only factors relating to risks to public health in deriving alternative "acceptable" levels of risk. However, in evaluating whether to further reduce the risk to provide for an ample margin of safety, EPA has also considered the extent to which plants would be forced to: (a) Install control technologies which are not cost effective or fully demonstrated and/or (b) curtail or stop production. These considerations are reflected in today's proposal to the extent that they apply to affected radionuclide sources.

With regard to the availability of technology to control air pollutants, EPA has in this case considered a technology available if it has been installed on a commercial scale in the United States and adequate data have been collected on plant and control equipment characteristics and performance. However, at various times in the past, EPA has considered emission standards which force plants to install technologies which do not meet these current "availability" criteria or cause facilities to curtail production or shut down. For example, EPA has in the past considered a technology "available" if it has been commercially demonstrated in other countries, even if no units have been installed in the United States. Also, EPA has considered bench- or pilot-scale demonstrations in order to judge reasonableness of expenditures for commercial demonstration of a given technology.

D. Effective Dose Equivalent

Since 1985, when EPA proposed dose standards regulating NRC-licensees and DOE facilities, a different methodology for calculating dose has come into widespread use, the effective dose equivalent (EDE). In 1987, EPA, in recommending to the President new guidance for workers occupationally exposed to radiation, accepted this methodology for the regulation of risks from radiation. This method, which was originally developed by the International Commission on Radiological Protection, will be used in all the dose standards promulgated by EPA in this notice. In the past, EPA dose standards were specified in terms of limits for specific organ doses and the "whole body dose", a methodology which is no longer consistent with current practices of radiation protection.

The EDE is simple, is more closely related to risk, and is recommended by the leading national and international advisory bodies. By changing to this new methodology, EPA will be converting to the commonly accepted international method for calculating dose. This will make it easier for the regulated community to understand and comply with our standards.

The EDE is the weighted sum of the doses to the individual organs of the body. The dose to each organ is weighted according to the risk that dose represents. These organ doses are then added together, and that total is the effective dose equivalent. In this manner, the risk from different sources of radiation can be controlled by a single standard. The weighting factors for the individual organs are listed in Table 2.

TABLE 2—WEIGHTING FACTORS FOR INDIVIDUAL ORGANS

Organ	Factor
Lung	.12
Breast	.15
Thyroid	.03
Gonads	.25
Bone Surface	.03
Red Bone Marrow	.12
Remainder	.30

EPA's risk models differ from those underlying the ICRP recommendations, primarily due to advances in the field of radiation risk estimation since the ICRP recommendations were published. As a result, the risks calculated by EPA are not strictly proportional to the EDE derived using ICRP quality factors and organ weighting factors. While the risk methodology underlying the ICRP EDE differs from that used by EPA, the widespread acceptance of the EDE approach make it a reasonable basis for regulation under the CAA.

E. Science Advisory Board Review

Beginning in 1984, EPA's Science Advisory Board (SAB) has conducted reviews of the risk assessment methods used in this rulemaking. EPA has worked closely with the SAB with respect to their comments and findings and believes it has been responsive to them.

In 1984, the SAB recommended that available scientific information be integrated into an assessment document that would lead from identification of emission sources through calculation of radiation dose and health risk and the associated degrees of uncertainty. This has been done in the Environmental Impact Statement accompanying this rulemaking.

In 1988 and again in 1989, the SAB considered the scientific merits of the EIS prepared by the Agency in support of this rulemaking. Estimates of health risk factors were found to be acceptable. Given below are some important specific SAB comments and the Agency's responses.

SAB Comment: EPA should use the effective dose equivalent concept for regulations protecting people from exposure to radiation.

EPA Response: This has been done in the final rules.

SAB Comment: EPA should use simple screening methods in implementation procedures such that only the largest users of radionuclides are required to report annually to EPA.

EPA Response: A simple screening procedure has been made part of the final rule.

SAB Comment: EPA should be certain that the data used to derive its estimates of risk are the most current available, and wherever practicable to base their assessments on consensus documents.

EPA Response: EPA agrees. The SAB has given specific advice on risk factors for low-LET radiation and for radon. The SAB approaches to these risk factors have been used in the risk assessments supporting this rulemaking. The Agency acknowledges that the BEIR–III report on which some of the risk factors are based may become out of date due to new data that are becoming available. EPA's risk factors will be revised to reflect these recent developments and to incorporate this newer data as soon as it is practical to do so. Preliminary information indicates that the most probable effect of this new information will be to increase somewhat the estimate of the number of health effects due to a unit dose of radiation. The size of this increase is not likely to be large enough to affect the decisions made under this rulemaking.

SAB Comment: The actual objective of the risk assessment should be made clear.

March 4: **Scientific and social dimensions of medical research**
readings:
Brandt, No Magic Bullet, Chapters 3 & 4

Erwin Ackerknecht "Anticontagionism between 1821 and 1867" Bull. Hist. of Med, 22 (1948), 562-593

Lloyd Stevenson "Science Down the Drain" Bull. Hist. Med.(1955) 79: 1-25

March 11: **Health policy and the health of society**
readings:
Brandt, No Magic Bullett, conclusion

Suzanne Buckley, "The Failure to resolve the Problem of VD Among Troops in Britain During World War I" in War and Society

Neil Sutherland "'To Create a Strong and Healthy Race': School Children in the Public Health Movement, 1880-1914." History of Education Quarterly (1972) 12:304-33.

Suzanne Buckley and Janice McGinnis, "VD and Public Health Reform in Canada" CHR (1982) 63:3-

March 18: **Science and the Woman Question**
readings:
Carroll Smith-Rosenberg and Charles Rosenberg, "The Female Animal: Medical and Biological Views of Woman and Her Role in Nineteenth-Century America" J. Am. Hist. (1973) 60:332-56.

Herbert Spencer, "Psychology of the Sexes" Popluar Science Monthly (1873) 4: 30-38.

Edward L. Thorndike "Sex in Education," The Bookman (1906) 23:211-14.

Veronica Strong-Boag "Canada's Women Doctors: Feminism Constrained" in Linda Kealey,ed., A Not Unreasonable Claim: Women and Reform in Canada, 1880-1920 (Toronto, 1979) pp.109-29.

March 25: **The Case of Barbara McKlintock - - is there a female science?**
readings:
Evelyn Fox Keller, A Feeling For the Organism: The Life and Work of Barbara McKlintock (New York: Freeman, 1983)

Elizabeth Fee, "Science and the Woman Problem: Historical Perspectives" in M. Teitelbaum, ed. Sex Differences: Social and Biological Perspectives (New York, 1976)pp.175-22

April 1: **Barbara McKlintock continued; conclusion**
readings:
Keller, A Feeling for the Organism

April 8: no class; test is due on Friday, April 10 at 12:00 noon

EPA Response: EPA has improved the presentation of risk in the EIS by more clearly stating overall assessment objectives. In particular, assessment objectives are carefully defined in terms of the individual and populations at risk. The number of people at risk and incidence is presented by range of risk. Radiation risks are compared with other risks and other radiation control recommendations. The objective of obtaining a best estimate of the dose and health implications for real persons and for populations is now explained in more detail together with explanations of how these groups are to be defined.

SAB Comment: EPA should use best estimates and ranges in the specification of risk and provide a detailed explanation of the uncertainties in the estimates themselves.

EPA Response: EPA agrees, but this is a large task. For the short term, we have performed a sensitivity analysis of the most important parameters using simplifying assumptions and have performed preliminary uncertainty analyses using a Monte Carlo simulation. These analyses have been presented in support of the final rule. For the long term, an Agency task group has been formed to plan and conduct more complete studies of the uncertainty question. This longer term effort will take a number of years to complete and will be dependent on the resources available.

EPA acknowledges the uncertainty in risk estimates, considers them when making risk management decisions and recognizes that a more complete quantitative analysis of uncertainty would be an improvement. However, it does not believe that such a complete analysis would change the decisions made in this rulemaking. A more complete discussion of uncertainty is to be found in chapter 7, volume 1 of the EIS.

V. Decision to List Under Section 112

Section 122(a) of the CAA required EPA to determine whether or not "emissions of radioactive pollutants * * * will cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health." Once an affirmative determination is made, that section requires EPA to list the substance under section 108(a)(1), governing National Ambient Air Quality Standards (NAAQS), 111(b)(1)(A), governing New Source Performance Standards, or 112(b)(1)(A), governing NESHAPs. The initial decision to list a substance does not constitute a decision to regulate any particular source category. EPA analyzed numerous studies which indicated that exposure to radionuclides can cause three major types of health effects: cancer, genetic damage, and developmental effects. After considering these health effects, EPA judged that radionuclides cause or contribute to air pollution which "may reasonably be anticipated to endanger public health" and that they should be listed under section 112(b)(1)(A) (44 FR 76738, Dec. 27, 1979). That decision was the first step in the regulatory process, and it was challenged in the current litigation. As a result, EPA has reevaluated the decision and the comments from the public during this rulemaking and has come to the conclusion that the original listing under section 112 is correct.

The first part of the listing decision, the "hazardousness" of radionuclides, is unchallenged. The evidence that radionuclides can cause cancer has, if anything, increased since 1979; see Volume 1 of the BID. The evidence now suggests that the risks from radiation exposure are higher than was believed at that time. While some people have expressed the view that, even though radiation can cause cancer, the amount of radionuclides that are released from a given source or industry is insignificant and do not present a risk, EPA believes that the results of the risk assessments for the source categories demonstrate the risk to public health that results from radionuclide emissions from industrial sources. Furthermore, as already discussed, EPA assumes radiation to be a non-threshold pollutant. This assumption, and EPA's risk assessments, support the listing decision.

Section 112(b)(1)(A) applies not merely to any "air pollutant" as do sections 108 and 111, but to a "hazardous air pollutant" that is defined as a pollutant that "causes or contributes to air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible or incapacitating reversible illness." Once a pollutant is determined to be a hazardous air pollutant, the only remaining step is for the Administrator to determine whether emissions of the pollutant present a risk warranting regulation under section 112—that is, whether it is a hazardous air pollutant "for which he intends to establish an emission standard" under that section. EPA has determined that radionuclides not only pose a risk of carcinogenicity and mutagenicity when emitted into the air (see, National Academy of Sciences, Commission on Biological Effects of Ionizing Radiation, Reports Number 3 and 4) but also are emitted in sufficient quantities as to create a risk warranting listing under section 112. Therefore, EPA reaffirms its prior conclusion that radionuclides should be listed for regulation under section 112.

EPA notes that several sources included among the source categories addressed by this rulemaking present very small risks when viewed individually. Several are predicted to emit a level resulting in an incidence of less than one case of cancer every 1000 years, and an associated MIR well below 1×10^{-4}, or even 1×10^{-5}. Based on this, it has been suggested that EPA should apply a significance test to these sources, and determine that they do not warrant regulation based on the insignificance of the risks presented.

EPA considers it unnecessary to reach that argument here. EPA applied the significance test of the Supreme Court's OSHA benzene opinion in its prior rulemakings on radionuclides to determine whether each source category warranted regulation. See *Industrial Union Dept., AFL–CIO* v. *American Petroleum Institute*, 448 U.S. 607 (1980) (interpreting the Occupational Safety and Health Act of 1970 as requiring that benzene sources be regulated only if they present "significant" risks); see also 50 FR 5189–5194 (Feb. 6, 1985), 49 FR 43905–43915 (Oct. 31, 1984) (discussing the requirement that risks from radionuclide air emission sources be significant in order to be regulated under Clean Air Act Section 112); Memorandum of A. James Barnes, General Counsel, to the Administrator of EPA entitled "Final Action on Radionuclides" (Oct. 23, 1984) (same); but see *Sierra Club* v. *Ruckelshaus*, 602 F. Supp. 892 (N.D. Cal. 1984). However, EPA believes it is unnecessary to reach this issue at this time since EPA believes that its standards should have no practical effect on the facilities to which such a test might have applicability. But see CAA section 307(d)(7)(B). Based on the record, EPA judges that the facilities that might be deemed to pose insignificant risks individually already emit radionuclides at levels well below the final standard. And, implementation of a significance test to each individual source would, for some source categories such as the NRC licensee category which contains several thousand sources, present huge implementation and resource problems for the Agency to examine each source individually.

The standards would have no practical impact on operations of sources that might be deemed to pose insignificant risks, other than to assure that emissions from these sources could not increase so as to exceed the

Tentative Schedule of Topics for Discussion:

Jan. 7: **Introduction**

Jan. 14: **Imperial Science: Science, God and Nature in Victorian Canada**
readings:
Carl Berger, Science God and Nature in Victorian Canada (Toronto: U of T. Press, 1983)
Richard Jarrell, "Science as Culture in Victorian Toronto" Atkinson Review of Canadian Studies (1983) 1:5-12

Jan. 21: **Imperial Science and the question of Race**
readings:
H. Aleyne Nicholson, "Man's Place in Nature," The Canadian Monthly and National Review, (1872) 1:35-45

David Mills, "The Missing Link in the Hypothesis of Evolution, or Derivative Creation" Canadian Magazine (1894) 3: 297-308.

David Mills, "Saxon or Slav, England or Russia?" Canadian Magazine (1898) 7:519-30.

Ramsay Cook, "The Roots of Modernsim, Darwinism and the Higher Critics" in The Regenerators: Social Criticism in Late Victorian Canada (Toronto: U of T. Press, 1985) pp.7-26.

Angus McLaren, "The Creation of a Haven for 'Human Thoroughbreds': The Sterilization of the Feeble Minded and Menatlly Ill in British Columbia" Canadian Historical Review (1986) 67:127-50.

recommended:
Carl Berger, "Race and Liberty: The Historical Ideas of Sir John George Burinot" CHA Report of the Annual Meeting (1965) 87-104.

Jan. 28: **Agriculture, Science and Empire**
readings:
T. H. Levere and R. Jarrell, "The Social Role of Victorian Science" and "The Diffusion of Useful Knowledge - - Science and Agriculture" in A Curious Field Book: Science and Society in Canadian History (Toronto: Oxford, 1974) pp. 107-111; 159-77.

Charles Rosenberg, "Science Pure and Science Applied: Two Studies in the Social Origin of Scientific Research" in No Other Gods pp.185-95.

Rosenberg "The Social Environment of Scientific Innovation: Factors in the Development of Genetics in the United States" in No Other Gods, pp.196-209.

R. Lewontin and R. Levins, "The Problem of Lysenkoism" in Hilary and Steven Rose, eds. Ideology of/in the Natural Sciences (Cambridge, MA: Schenkman, 1979) pp.173-206.

standard. Moreover, imposition of standards assure that EPA would be notified of significant increases in emissions at these sources, or other relevant changes in circumstances, such as changes in the location or exposure of the most exposed individual, that might require additional regulatory attention.

VI. Discussion of Source Categories

The regulatory decisions reached today are based on the risk assessments and other factors available in the rulemaking record. This rule is also based on consideration of information received during the comment period to the rulemaking.

A. Department of Energy Facilities

1. Introduction

The DOE administers many facilities, including government-owned, contractor-operated facilities across the country. Some facilities conduct nuclear energy and weapons research and development, some enrich uranium and produce plutonium for nuclear weapons and reactors, and some process, store and dispose of radioactive wastes. These facilities contain significant amounts of radioactive material and emit radionuclides into the air. Other facilities contain large stockpiles of waste ore which emit large quantities of radon. A discussion of those DOE facilities appears as a separate section later in this Preamble. EPA is considering the two categories separately in this rulemaking because the two categories employ different control methods. Some of the DOE facilities emitting radionuclides are on large sites covering hundreds of square miles in remote locations. Some of the smaller sites resemble typical industrial facilities and are located in suburban areas.

In total, DOE has approximately 30 major sites that emit radionuclides. These facilities emit a wide variety of radionuclides in various physical and chemical states. Emissions from various DOE facilities represent many types of radionuclides and both internal and external dose pathways (although specific facilities may emit only one or two radionuclides affecting only one pathway).

DOE facilities are presently covered by a radionuclide NESHAP which limits emissions such that no individual receives a whole body dose of 25 mrem/y or receives a dose of 75 mrem/y to any organ. DOE also controls releases from these facilities under DOE orders which limit calculated doses to the general public to less than 100 mrem/y from all sources and pathways. By incorporating the ALARA concept into its Orders, DOE has kept the dose to the public well below 100 mrem/y. The NESHAP also mandates that DOE send annual reports of emissions to EPA. The information gathered from these reports contributed to EPA's risk assessment of DOE facilities.

2. Estimates of Exposure and Risk

EPA's risk assessment of DOE facilities is a site-by-site assessment. Emissions are based on DOE's 1986 report of emissions, meteorological data are from on-site towers or from nearby weather stations, and population distributions within 80 km are based on U.S. census tract data. EPA has updated its risk assessment with information received during the comment period. EPA has a high degree of confidence in the results of this risk assessment.

According to EPA's analysis, all DOE facilities are in compliance with the current NESHAP. The risk to the most exposed individual is approximately 2.0×10^{-4}. DOE facilities are estimated to cause 0.28 fatal cancers per year to the exposed populations within 80 km of all DOE facilities. Most of the exposed population has a lifetime fatal cancer risk of less than 1×10^{-6}.

Table 3 presents example scenarios to show how different emission levels would result in different health risk profiles. The table presents the risk estimates at baseline in terms of estimated annual fatal cancer incidence, maximum individual lifetime risk, total population exposed at or above particular risk levels (i.e., risk distribution), and annual incidence attributable to the population exposed at each risk level. The table also presents available estimates of annual incidence and maximum individual lifetime risk for a lower emission level.

3. Application of Decision Methodology to the DOE Facilities Source Category

The decision that results from the application of the multifactor policy approach to the DOE source category is described below.

Decision on Acceptable Risk. As stated earlier, the maximum individual risk to any individual is 2.0×10^{-4}. In establishing the policy for setting NESHAPs in the context of benzene, the Agency determined that emissions resulting in a lifetime MIR no greater than approximately 1×10^{-4} are presumptively acceptable. In light of the numerous uncertainties in both establishing the parameters for the risk assessment and in modelling actual emissions and exposure, as well as the recognition that in achieving compliance, sources will generally control so as to ensure that a buffer exists below the actual level of a standard, EPA judges that the MIR of 2.0×10^{-4} is essentially equivalent to the presumptively safe level of approximately 1×10^{-4}. EPA then considered the other risk factors in order to determine whether the baseline level is acceptable.

The estimated annual incidence is 0.28 fatal cancers per year, or 1 case every 4 years; in addition, there would be an approximately equal number of non-fatal cancers per year. Very few people are at risks greater than 1.0×10^{-4}, and approximately 98% of people within 80 km of DOE facilities receive risks of less than 1×10^{-6}.

After examining these factors, the Administrator has determined that the baseline emission levels and risks from DOE facilities are acceptable.

Decision on Ample Margin of Safety. In addition to reexamining all the health-related factors discussed above, EPA has also examined the cost, scientific certainty, and technological feasibility of control technology necessary to lower emissions from DOE facilities. The results of this analysis may be seen in Table 4. Alternative I, a standard of 10 mrem/y, representing the current baseline emissions, was compared with alternative II, a standard of 3 mrem/y a standard, equivalent to 1×10^{-4}.

A comparison of the two alternatives indicates that only a very small reduction in incidence would occur, from 0.28 to 0.25, or 1 case every 33 years, with a concommitant reduction in MIR from 2×10^{-4} to 1×10^{-4}. Based on this very small reduction in incidence, the small decrease in individual risk that would result, and on the costs of achieving Alternative II, EPA has determined that a 10 mrem standard provides an ample margin of safety by continuing regulation of this category to insure that the current levels of emissions are not increased. Requirements of the rule, such as the submission of yearly reports and obtaining prior approval of new construction or modification, assure that DOE facilities will keep emissions at or below an acceptable level insuring an ample margin of safety. Moreover,

9. Nov 3 Measuring intelligence (Gould, The Mismeasure of Man, pp. 146-192)

5 Measuring intelligence (Gould, The Mismeasure of Man, pp. 192-233; 321-336)

10. 10 Science as Metaphor (Rifkin, Algeny, I & II)

12 Passing of Darwinism (Rifkin, Algeny, III & IV)

11. 17 Nature in the Age of Biotechnology (Rifkin, Algeny, V)

19 The New Cosmology & its Implications (Rifkin, Algeny, VI & VII)

12. 24 **Proposal due**; Bronowski, Science and Human Values, 1 & 2

26 Bronowski, Science and Human Values, 3 & 4

13. Dec 1 **3rd exercise due**; Snow, The Two Cultures, pp. 1-51

2 Snow, The Two Cultures, pp. 53-100

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because each facility subject to this rule must demonstrate compliance with the 10 mrem/y ede emissions standard, it is likely that most, if not all, exposed individuals will receive a dose significantly less than 10 mrem/y ede. Therefore, EPA believes that limiting emissions to their current level by imposition of a standard of 10 mrem/y EDE to replace the previous standard, will protect public health with an ample margin of safety. EPA is promulgating a NESHAP mandating that radionuclide emissions from DOE facilities shall not cause any individual to receive a dose of greater than 10 mrem/y ede.

TABLE 3.—DOE FACILITIES

Description: The facilities owned and controlled by DOE. These include nuclear weapons production, testing and research facilities and other nuclear research and production facilities. There are 30 major DOE facilities that release radionuclides into the air.3

	Alternative I (baseline)	Alternative II
Maximum individual risk (lifetime)	2.0×10^{-4}	1×10^{-4}
Incidence within 80 km (death/y)	0.26	0.25
Risk individual		
E-2 to E-1	0	0
E-3 to E-2	0	0
E-4 to E-3	(*)	(*)
E-5 to E-4	590,000	590,000
E-6 to E-5	1M	260,000
less E-6	65M	65M
Risk incidence		
E-2 to E-1	0	0
E-3 to E-2	0	0
E-4 to E-3	(*)	(*)
E-5 to E-4	0.26	0.22
E-6 to E-5	0.032	0.0074
less E-6	0.010	0.014

Other Health Impacts: Total cancers no more than twice fatal cancers.

* There are fewer than 25 people at this risk. However, we cannot quantify the number because detailed demographics have not been obtained.

TABLE 4.—DOE FACILITIES

Alternative	MIR	Incidence	Increment incidence reduction	Total incidence reduction	Increment capital cost	Increment annualized cost	Total annualized cost
I (Baseline)	2.0×10^{-4}	0.26					
II	1.0×10^{-4}	0.25	0.03	0.03	$ 6.9M	$ 0.2M	$ 0.2M

Comments: Alternative I: Baseline rule, emission limit of 10 mrem/y ede—highest emissions are from Los Alamos and Oak Ridge.
Alternative II: Emission limit of 3 mrem/y ede (equivalent to a MIR of 1×10^{-4})—the following controls are needed: Los Alamos—beam stops and delay lines; Oak Ridge—HEPA filters, particulate scrubbers, and tritiated water capture.

4. Implementation

a. *Introduction.* ORP's experience in implementing the existing radionuclide NESHAP covering DOE facilities has shown that implementation of the current standard has several problems. EPA has developed a new system for implementing the NESHAP designed to overcome the limitations in the present standard.

b. *Yearly Reports.* The implementation system for the NESHAP is designed to provide EPA with yearly reports on the levels of emissions from regulated facilities and resulting doses. Presently, DOE facilities monitor their emissions and make annual reports to EPA. These reports shall continue under the new NESHAP. Although the report is based on a calendar year the dose standard applies to any year, i.e. any period of 12 consecutive months. Since these reports provide EPA with the information it needs, DOE facilities are exempted from the requirements of 61.10.

c. *Methods of Measurement.* Because the thresholds for measurement are much lower than the standard, under certain circumstances the concentration and potential doses associated with release points that are above the threshold may be so low that direct measurement may not be practical. With prior EPA approval, DOE may determine these emissions through alternate procedures.

d. *Definition of a Facility.* A problem in implementing the current standard is the ambiguity associated with the present definition of a facility. To resolve this ambiguity, the new rule specifies that all the buildings, structures and operations within one contiguous site shall be considered a single facility. For example, the entire DOE facility at Oak Ridge, Tennessee must meet the current standard of 10 mrem/y ede, instead of each individual building meeting the 10 mrem/y ede standard.

e. *Distinction Between Construction and Modification.* A potential problem resulting from EPA's definition of a facility as all the buildings, structures and operations within a given plant site, is confusion over whether the construction of a new building is part of an existing facility, is new construction, or is a modification of an existing facility. This rule specifies that the construction of a new building is new construction at the facility and not a modification of the facility. This distinction is important because all new construction needs to be checked to see whether or not it needs prior approval but modifications which do not cause a net increase in the rate of emissions from the facility do not need prior approval.

f. *Prior Approval of New Construction or Modification.* EPA will not change the basic definition of modification that exists at 40 CFR 61.15. A change that will result in any increase in the rate of emissions is a modification, no matter how small that increase is. This includes cases where the modification has the potential to increase emissions above prior actual emissions. However, to reduce unnecessary paperwork, it is appropriate to avoid applications for approval in cases of small changes.

Therefore, EPA is promulgating a system under which DOE facilities will use CAP-88 to determine the dose to the most exposed individual due to the modification or new construction. If the estimated maximum individual dose added by the new construction or modification is less than 1% of the standard, then the modification or new construction does not need prior approval.

In making the determination of dose for *this purpose*, DOE must use the emission factors and source term determination from "BID: Procedures Approved for Demonstrating Compliance with the Dose Limits Established by 40 CFR part 61, subpart I." (BID: Compliance) or other procedures for which EPA has granted prior approval.

HPS 110 F
SCIENCE AND SOCIAL RESPONSIBILITY

TEXTS (available at the Victoria College Bookstore):

Bronowski, Jacob. Science and Human Values. Rev. ed. New York: Harper & Row, 1972. Paper.

Drake, Stillman. Discoveries and Opinions of Galileo Galilei. New York: Doubleday, 1957. Paper.

Dyson, Freeman. Disturbing the Universe. New York: Harper & Row, 1981. Paper.

Gould, Stephen Jay. The Mismeasure of Man. New York & London: W. W. Norton, 1981. Paper.

--------. Hen's Teeth and Horse's Toes. New York & London: W. W. Norton, 1983. Rpt. 1984. Paper.

Rifkin, Jeremy. Algeny. New York: Viking, 1983. Paper.

Snow, C. P. The Two Cultures. Cambridge: Cambridge Univ. Press. Paper.

COURSE REQUIREMENTS:

Term work will consist of three assignments, each requiring a written submission of two or three typed pages. Each assignment will be worth 15% of the final grade, for a total of 45%. There will be a penalty of 1% per day for late assignments. The tutorials are meant, in part, to allow for discussion of these assignments and to assist with their completion, and are therefore to be considered an essential part of the course. Attendance and participation in the tutorials is worth another 15% of the final grade. Finally, a three-hour final examination, consisting of questions based on or similar to the assignments, will make up the remaining 40%.