ALASKA LEGISLATURE COMMITTEE FILES 1987-1988 8672
4490 HCRA HB 519 62

How certain are scientists of the risks?

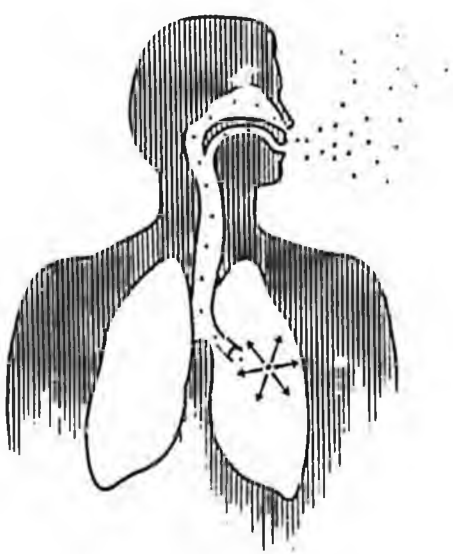
With exposure to radon, as with other pollutants, there is some uncertainty about the amount of health risk. Radon risk estimates are based on scientific studies of miners exposed to varying levels of radon in their work underground. Consequently, scientists are considerably more certain of the risk estimates for radon than they are of those risk estimates which rely solely on studies of animals.

To account for the uncertainty in the risk estimates for radon, scientists generally express the risks associated with exposure to a particular level as a *range* of numbers. (The risk estimates given in this booklet are based on the advice of EPA's Science Advisory Board, an independent group of scientists established to advise EPA on various scientific matters.)

Despite some uncertainty in the risk estimates for radon, it is widely believed that the greater your exposure to radon, the greater your risk of developing lung cancer.

How does radon cause lung cancer?

Radon, itself, naturally breaks down and forms radioactive decay products. As you breathe, the radon decay products can become trapped in your lungs. As these decay products break down further, they release small bursts of energy which can damage lung tissue and lead to lung cancer.



When did radon become a problem?

Radon has always been present in the air. Concern about elevated indoor concentrations first arose in the late 1960's when homes were found in the West that had been built with materials contaminated by waste from uranium mines. Since then, cases of high indoor radon levels resulting from industrial activities have been found in many parts of the country. We have only recently become aware, however, that houses in various parts of the U.S. may have high indoor radon levels caused by *natural* deposits of uranium in the soil on which they are built.

Does every home have a problem?

No, most houses in this country are not likely to have a radon problem; but relatively few houses do have highly elevated levels. The dilemma is that, right now, no one knows which houses have a problem and which do not. You may wish to call your state radiation protection office to find out if any high levels have been discovered in your area.

Many states, as well as the federal government, are sponsoring work to identify areas of the country which are likely to have indoor radon problems. However, early results from this work are inconclusive. If you are concerned that you may have an indoor radon problem, you should consider having your home tested.

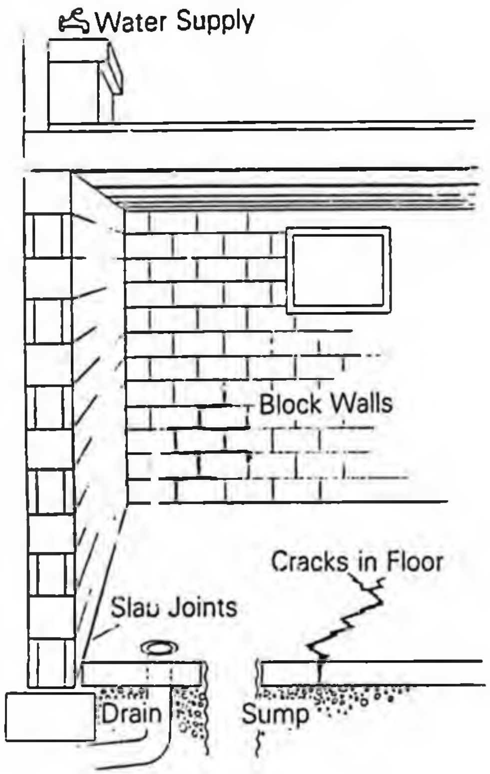
How does radon get into a home?

Radon is a gas which can move through small spaces in the soil and rock on which a house is built. Radon can seep into a home through dirt floors, cracks in concrete floors and walls, floor drains, sumps, joints, and tiny cracks or pores in hollow-block walls.

Radon also can enter water within private wells and be released into a home when the water is used. Usually, radon is not a problem with large community water supplies, where it would likely be released into the outside air before the water reaches a home. (For more information concerning radon in water, contact your state's radiation protection office.)

In some unusual situations, radon may be released from the materials used in the construction of a home. For example, this may be a problem if a house has a large stone fireplace or has a solar heating system in which heat is stored in large beds of stone. In general, however, building materials are not a major source of indoor radon.

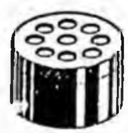
Common Radon Entry Points



How is radon detected?

Since you cannot see or smell radon, special equipment is needed to detect it. The two most popular, commercially-available radon detectors are the charcoal canister and the alpha track detector. Both of these devices are exposed to the air in your home for a specified period of time and sent to a laboratory for analysis.

Charcoal Canisters
Test Period: 3 to 7 days
Approximate Cost: $10 to $25 for one canister



Alpha Track Detectors
Minimum Test Period: 2 to 4 weeks
Approximate Cost: $20 to $50 for one detector; discounts for multiple detectors

There are other techniques—requiring operation by trained personnel—which can be used to measure radon levels, but such techniques may be more expensive than the devices shown above.

Your measurement result will be reported to you in one of two ways. Results from devices which measure radon decay products are reported as "Working Levels" (WL). Results from devices which measure concentrations of radon gas are reported as "picocuries per liter" (pCi/l).

How can I get a radon detector?

Homeowners in some areas are being provided with detectors by their state or local government. In many areas, private firms offer radon testing. Your state radiation protection office may be able to provide you with information on the availability of detection devices or services.

The U.S. Environmental Protection Agency conducts a Radon Measurement Proficiency Program. This voluntary program allows laboratories and businesses to demonstrate their capabilities in measuring indoor radon. The names of firms participating in this program can be obtained from your state radiation protection office or from your EPA regional office.

How should radon detectors be used?

Obtaining a useful estimate of the radon level in your home may require that several detectors be used to make measurements in different areas. Following the steps below should provide the information needed as you decide whether or not further action is advisable. (In making radon measurements, you should be sure to follow the instructions of the manufacturer as to the proper exposure period for the particular device you are using.)

Step One: The screening measurement

The first step you should take is to have a short-term "screening" measurement made to give you an idea of the highest radon level in your home. Thus, you can find out quickly and inexpensively whether or not you have a potential radon problem.

The screening measurement should be made in the lowest livable area of your home (the basement, if you have one). All windows and doors should be closed for at least 12 hours prior to the start of the test, and kept closed as much as possible throughout the testing period. This is necessary to keep the radon level relatively constant throughout the testing period. Because of the need to keep the windows closed as much as possible, we recommend that you make short-term radon measurements during the cool months of the year.

Step Two: Determining the need for further measurements

In most cases, the screening measurement is not a reliable measure of the *average* radon level to which you and your family are exposed. Since radon levels can vary greatly from season to season as well as from room to room, the screening measurement only serves to indicate the *potential* for a radon problem. Depending upon the result of your screening measurement, you may need to have follow-up measurements made to give you a better idea of the average radon level in your home.

The following guidance may be useful to you in determining the urgency of your need for follow-up measurements.

If your screening measurement result is **greater than about 1.0 WL or greater than about 200 pCi/l**, you should perform follow-up measurements as soon as possible. Expose the detectors for no more than one week. Doors and windows should be closed as much as possible during testing. You should also consider taking actions (see page 13) to immediately reduce the radon levels in your home.

If your screening measurement result is **about 0.1 WL to about 1.0 WL or about 20 pCi/l to about 200 pCi/l**, perform follow-up measurements. Expose detectors for no more than three months. Doors and windows should be closed as much as possible during testing.

If your screening measurement result is **about 0.02 WL to about 0.1 WL or about 4 pCi/l to about 20 pCi/l**, perform follow-up measurements. Expose detectors for one year, or make measurements of no more than one week duration during each of the four seasons.

If your screening measurement result is **less than about 0.02 WL or less than about 4 pCi/l**, follow-up measurements are probably not required. If the screening measurement was made with the house closed up prior to and during the testing period, there is relatively little chance that the radon concentration in your home will be greater than 0.02 WL or 4 pCi/l as an annual average.

Step Three: The follow-up measurement

Follow-up measurements will provide you with a relatively good estimate of the average radon concentration to which you and your family are exposed. **We strongly recommend that you make follow-up measurements before you make any final decisions about whether to undertake major efforts to permanently correct the problem.**

Follow-up measurements should be made in at least two lived-in areas of your home. If your home has lived-in areas on more than one floor, you should make measurements in a room on each of the floors. An example is to take a measurement in the living room on the first floor and another in a second-floor bedroom. The results of the follow-up measurements should be averaged together.

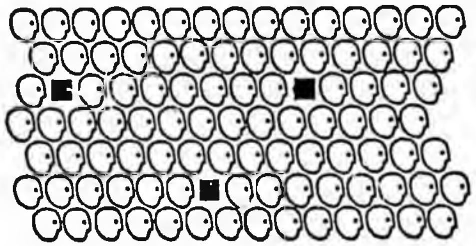
What do my test results mean?

The results of your follow-up measurements provide you with an idea of the average concentration throughout your home. The actual risk you face depends upon the amount of time you are exposed to this concentration.

The figures on the facing page illustrate the number of lung cancer deaths, out of a group of 100 people, that scientists would attribute to exposure to specific levels of indoor radon. The first three figures assume that these 100 individuals spent 75 percent of their time in the dwelling for 70 years. The numbers below each picture indicate what scientists consider to be a reasonable range of estimates of lung cancer deaths that could be attributed to the radon exposure. This is **in addition** to the number of lung cancer deaths attributed to other causes. (On average, about four people out of a hundred die of lung cancer from all causes combined.) The pictures represent the midpoint of the ranges.

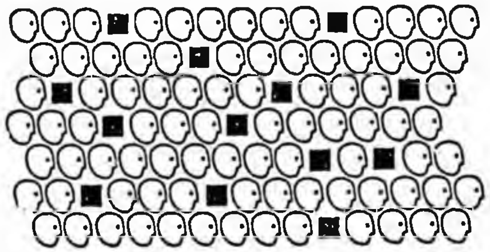
Lung Cancer Deaths
Associated With Exposure
To Various Radon Levels
Over 70 Years

WL = 0.02
pCi/l = 4



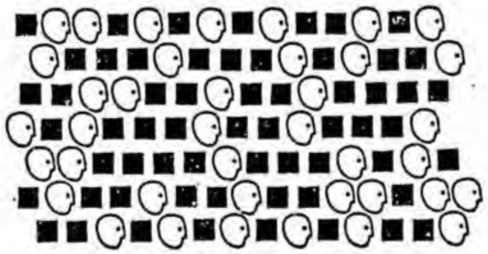
Between 1 and 5 out of 100

WL = 0.1
pCi/l = 20



Between 6 and 21 out of 100

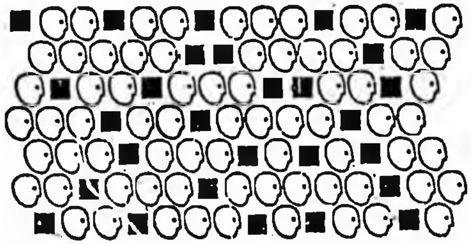
WL = 1.0
pCi/l = 200



Between 44 and 77 out of 100

If these same 100 individuals had lived only 10 years (instead of 70) in houses with radon levels of about 1.0 WL, the number of lung cancer deaths expected would be:

WL = 1.0
pCi/l = 200



Between 14 and 42 out of 100

Another way to think about the risk associated with radon exposure is to compare it with the risk from other activities. The chart below gives an idea of how exposure to various radon levels over a lifetime compares to the risk of developing lung cancer from smoking and from chest x-rays. The chart also compares these levels to the average indoor and outdoor radon concentrations.

As you look at the chart, be sure to use the proper radon-level column for your results (either WL or pCi/l).

Radon Risk Evaluation Chart

pCi/l	WL	Estimated number of lung cancer deaths due to radon exposure (out of 1000)	Comparable exposure levels	Comparable risk
200	1	440—770	1000 times average outdoor level	More than 60 times non-smoker risk; 4 pack-a-day smoker
100	0.5	270—630	100 times average indoor level	20,000 chest x-rays per year
40	0.2	120—380		
20	0.1	60—210	100 times average outdoor level	2 pack-a-day smoker
10	0.05	30—120	10 times average indoor level	1 pack-a-day smoker
4	0.02	13—50		5 times non-smoker risk
2	0.01	7—30	10 times average outdoor level	200 chest x-rays per year
1	0.005	3—13	Average indoor level	Non-smoker risk of dying from lung cancer
0.2	0.001	1—3	Average outdoor level	20 chest x-rays per year

How quickly should I take action?

In considering whether and how quickly to take action based on your test results, you may find the following guidelines useful. EPA believes that you should try to permanently reduce your radon levels as much as possible. Based on currently available information, EPA believes that levels in most homes can be reduced to about 0.02 WL (4 pCi/l).

If your results are about 1.0 WL or higher, or about 200 pCi/l or higher:
Exposures in this range are among the highest observed in homes. Residents should undertake action to reduce levels as far below 1.0 WL (200 pCi/l) as possible. We recommend that you take action within several weeks. If this is not possible, you should determine, in consultation with appropriate state or local health or radiation protection officials, if temporary relocation is appropriate until the levels can be reduced.

If your results are about 0.1 to about 1.0 WL, or about 20 to about 200 pCi/l:
Exposures in this range are considered greatly above average for residential structures. You should undertake action to reduce levels as far below 0.1 WL (20 pCi/l) as possible. We recommend that you take action within several months.

If your results are about 0.02 to about 0.1 WL, or about 4 pCi/l to about 20 pCi/l:
Exposures in this range are considered above average for residential structures. You should undertake action to lower levels to about 0.02 WL (4 pCi/l) or below. We recommend that you take action within a few years, sooner if levels are at the upper end of this range.

If your results are about 0.02 WL or lower, or about 4 pCi/l or lower:
Exposures in this range are considered average or slightly above average for residential structures. Although exposures in this range do present some risk of lung cancer, reductions of levels this low may be difficult, and sometimes impossible, to achieve.

Remember: There is increasing urgency for action at higher concentrations of radon. The higher the radon level in your home, the faster you should take action to reduce your exposure. If you find elevated radon concentrations in your home, you should take the relatively easy, short-term actions described on page 13.

Are there other factors I should consider?

Most of the risk information given in this pamphlet, as well as the recommendations for taking corrective action, are based on the general case. Your individual living patterns could influence your assessment of your risk and your decisions about the need for further action. Your answers to the following questions may help you evaluate your personal risk.

- Does anyone smoke in your home? Scientific evidence indicates that smoking may increase the risk of exposure to radon. In addition, smoking significantly increases your overall risk of lung cancer.
- Do you have children living at home? Although there are no studies of children exposed to radon to determine whether they are more sensitive than adults, some scientific studies of other types of radiation exposure indicate that children may be more sensitive. Consequently, children could be more at risk than adults from exposure to radon.
- How much time does any family member spend at home? The risk estimates given in this pamphlet assume that 75 percent of a person's time is spent at home. If you or your family spend more or less time at home, you should take this into consideration.
- Does anyone sleep in your basement? Since radon concentrations tend to be greater on the lower levels of a home, a person who sleeps in the basement is likely to face a greater risk than a person who sleeps in a second-floor bedroom.
- How long will you live in your home? The risk estimates in this booklet are based on the assumption that you will be exposed to the radon level found in your home for roughly 70 years. As you evaluate your potential risk, therefore, you might consider the total amount of time you expect to live in your home. But remember: other houses you have lived in—or will live in—may have the same or higher radon levels.

How can I reduce my risk from radon?

Your risk of lung cancer from exposure to radon depends upon the amount of radon entering your home and the length of time it remains in your living areas. Listed below are some actions you might take to immediately reduce your risk from radon. These actions can be done quickly and with minimum expense in most cases.

- Stop smoking and discourage smoking in your home. By doing so, you should reduce your family's overall chance of developing lung cancer, as well as reducing your family's risk from radon exposure.
- Spend less time in areas with higher concentrations of radon, such as the basement.
- Whenever practical, open all windows and turn on fans to increase the air flow into and through the house. This is especially important in the basement.
- If your home has a crawl space beneath, keep the crawl-space vents on all sides of the house fully open all year.

While the above actions will help reduce your risk from radon, they generally do not offer a long-term solution. You can find more information about permanent, cost-effective solutions to a radon problem in the EPA publication, *Radon Reduction Methods: A Homeowner's Guide*. A copy of this booklet may be obtained from your state radiation protection office or from your EPA regional office.

Before undertaking major modifications to your home, we recommend that you consult with your state radiation protection office to obtain whatever specific advice or assistance they may be able to provide for your particular situation.

Sources of Information

If you would like further information or explanation on any of the points mentioned in this booklet, you should contact your state radiation protection office.

If you have difficulty locating this office you may call your EPA regional office listed below. They will be happy to provide you with the name, address, and telephone number for your appropriate state contact.

State—EPA Region

Alabama—4	Idaho—10	Missouri—7	Pennsylvania—3
Alaska—10	Illinois—5	Montana—8	Rhode Island—1
Arizona—9	Indiana—5	Nebraska—7	South Carolina—4
Arkansas—6	Iowa—7	Nevada—9	South Dakota—8
California—9	Kansas—7	New Hampshire—1	Tennessee—4
Colorado—8	Kentucky—4	New Jersey—2	Texas—6
Connecticut—1	Louisiana—6	New Mexico—6	Utah—8
Delaware—3	Maine—1	New York—2	Vermont—1
District of Columbia—3	Maryland—3	North Carolina—4	Virginia—3
Florida—4	Massachusetts—1	North Dakota—8	Washington—10
Georgia—4	Michigan—5	Ohio—5	West Virginia—3
Hawaii—9	Minnesota—5	Oklahoma—6	Wisconsin—5
	Mississippi—4	Oregon—10	Wyoming—8

EPA Regional Offices

EPA Region 1
Room 2203
JFK Federal Building
Boston, MA 02203
(617) 223-4845

EPA Region 2
26 Federal Plaza
New York, NY 10278
(212) 264-2515

EPA Region 3
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-8320

EPA Region 4
345 Courtland Street, NE.
Atlanta, GA 30365
(404) 881-3776

EPA Region 5
230 South Dearborn Street
Chicago, IL 60604
(312) 353-2205

EPA Region 6
1201 Elm Street
Dallas, TX 75270
(214) 767-2630

EPA Region 7
726 Minnesota Avenue
Kansas City, KS 66101
(913) 236-2803

EPA Region 8
Suite 1300
One Denver Place
999 18th Street
Denver, CO 80202
(303) 283-1710

EPA Region 9
215 Fremont Street
San Francisco, CA 94105
(415) 974-8076

EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
(206) 442-7660

(8) HB519

Alaska State Legislature

House of Representatives

Committee on
Community & Regional Affairs

Pouch V
State Capitol
Juneau, Alaska 99811
(907) 465-4833

TO: Rep. Henry Springer, Chairman HCRA

FROM: David C. Harrison, P. A., HCRA

BILL REVIEW: March 7, 1988

RE: HB 519 "An Act establishing a revolving loan fund for radon mitigation; and providing for an effective date." Sponsors: Davis, Koponen, Ulmer

*Section 1. Findings: Legislative findings indicate exposure to radon in homes can cause some health concerns. That some Alaskan homeowners do not have the financial resources to install radon mitigation systems in their homes. State response to the health threat posed by radon is necessary and should continue or expand.

COMMENT: S. Heidersdorf, a radiological physicist of the Division of Public Health, State of Alaska, reported results of 246 tests for radon in 246 Alaska homes and provided the following:

204 homes with 4 or less (PCl/1) No remedial action -
16 homes with 5 - 8 " could consider some action
(18 homes with 9 - 20 " radon mitigation should be
8 homes with 20+ " taken with concentration of
radon, picocuries per liter of air.) (A picocurie is one trillionth of a curie, a common unit of radioactivity.) Radon is a colorless, radioactive, heavy gaseous element. Curie is a unit of radioactivity of a sample of an element in which 3.7×10^{10} nuclear disintegrations occur each second.

Natural Resources Geologic Management, a component of Land and Public Safety, states that Alaska is one of the few states for which EPA has little or no information pertaining to radon potential or actual data from radon surveys of homes or public buildings. Limited data have been or are currently being gathered in land surveys of selected areas of the state. We do not have enough data to estimate the magnitude of the statewide radon problem. See No. 4 HB 519.

*Sec. 2. AS 44.47. is amended by adding new sections to read:

ARTICLE 11A RADON MITIGATION REVOLVING LOAN FUND.

Sec. 44.47.650. RADON MITIGATION REVOLVING LOAN FUND. There is in the Department of Community and Regional Affairs the randon mitigation revolving loan fund to carry out the purposes of AS 44.47.650 - 44.47.658. The fund may not be used for any other purpose.

COMMENT: This Section provides legal authority to establish the radon revolving loan fund within the DCRA.

Sec. 44.47.652 POWERS AND DUTIES OF THE DEPARTMENT IN ADMINISTERING THE FUND.

The DCRA may make loans and adopt regulations as stated within this bill.

The DCRA shall develop eligibility standards for loans and adopt guidelines for the determinations of loan terms. Also provides for the disposing of property acquired through default or foreclosure of a loan hereunder.

Sec. 44.47.654 LOAN TERMS AND PAYMENTS

Loans may not exceed $10,000.

Duration of loan may not exceed 10 years.

Interest rate on a loan is the annual rate charged member banks for advances by the 12th Federal Reserve District on the day the loan is made.

All principal and interest payments shall be paid into the radon mitigation revolving loan fund.

COMMENTS: General loan conditions established are considered basic loan conditions established under similar laws dealing with state loans.

Sec. 44.47.656 ELIGIBILITY FOR LOANS.

1. radon measurements in the homeowner's residence exceeded six picocuries;

2. a homeowner has applied for a loan to mitigate the effects of radon from a state chartered or a federal lending institution, and the application has been rejected;

3. the homeowner submits to the DCRA a plan for the use of the loan funds that is approved by the commissioner;

4. the applicant meets additional eligibility standards established by DCRA under AS 44.47.652.

COMMENTS: Items 1 through 4 establishes eligibility for radon mitigation state loans from DCRA. Item number 2 particularly points to a loan applicant that has been rejected a loan from a state or a federal lending institution may apply for a radon mitigation from DCRA.

Sec. 44.47.568. SPECIAL ACCOUNT ESTABLISHED.

A foreclosure expense account is established as a reserve from fund equity.

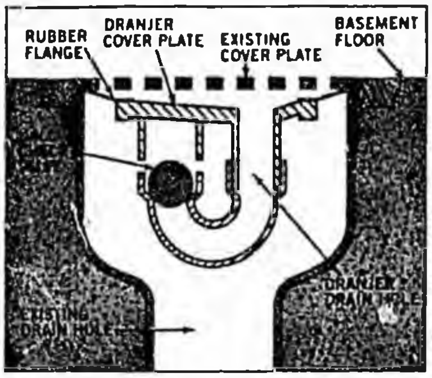
Allows the DCRA commissioner to expend money credited to the foreclosure expense account when necessary to protect the state's security interest in collateral on loans made under AS 44.47.650 - 44.47.658 or to defray expenses incurred during foreclosure proceedings after default by an obligor.

COMMENT: Provides general authority to initiate ways and means to accomplish legal tasks regarding loans and property encumbered through state loans per purposes of this bill.

Radon roadblock

"In Winnipeg we had a radon problem," recalls Harold Westdal, president of Dranjer Corp. Of 53 homes tested there, more than a third had concentrations of radon gas, a carcinogen, above the U.S. Environmental Protection Agency's recommended limit—even in upstairs bedrooms.

Westdal's company designed a simple assembly, called a Dranjer, to keep radon from wafting in through basement drains, a common entry point (see drawing). Contractors began installing Dranjers in homes last year. The devices have helped reduce radon levels, and they have some beneficial side effects.



Rubber flange in Dranjer's retrofit assembly is trimmed to match existing cover plate, which holds it in place to seal basement floor drain. Ball check valve permits water to flow downward, but prevents upward gas infiltration.

Winnipeg's problem isn't unique. During the last two winters, the EPA and state agencies tested more than 15,000 U.S. homes for radon gas. About one fifth had radon readings above that at which the EPA recommends remedial action. Measurements taken in the summer, when houses receive better ventilation, are usually lower. Still, the survey shows that radon is a widespread problem.

For some, it's a fatal problem. The EPA estimates that radon causes between 5,000 and 20,000 lung-cancer deaths a year.

Radon, a radioactive decay product of uranium and radium, rises from rocks and soil. Luckily, monitoring the gas is easy [Sept. '87]; and reducing infiltration isn't necessarily difficult or expensive. In fact, sealing off a basement floor drain can cut indoor radon levels by nearly half, according to studies by Canada's National Research Council.

However, an ordinary seal defeats a drain's purpose: to provide an exit route for laundry discharges, rainwater seepage, and spills. Even water traps (curved sections of pipe that hold water, obstructing airflow) may not stop radon, and they often dry up.

In Winnipeg, the Dranjer seal not only plugged radon leaks, but also solved a few other problems. Some residents had complained about odors rising from sewer lines, reports Westdal. He says Dranjers keep out noxious fumes, mold spores, and insects. Cold air, too: In chilly climates, the seals reduce energy bills by up to 10 percent, Westdal claims.

Dranjers are sold by hardware chains and cost less than $20. Retrofit models can be placed over sumps or drains. Dranjers made for new installations have a retaining ring that is set into the basement floor when the foundation is poured. Dranjer Corp., 1441 Pembina Hwy., Winnipeg, Man. R3T 2C4.—*Dawn Stover*

(10) HB 519

Alaska State Legislature

Representative Mike Davis District 19

P.O. Box V
Juneau, Alaska 99811
(907) 456-4930/4941

Interim Office:
P.O. Box 81435
Fairbanks, Alaska 99708
(907) 456-8161

TO: Rep. Henry Springer
Chairman, House Community & Regional Affairs Committee
FROM: Rep. Mike Davis
DATE: April 6, 1988
RE: HB 519, establishing a radon mitigation revolving loan fund in the Dept. of Community and Regional Affairs.

Attached is a draft CS for HB 519 which I have prepared in response to concerns raised by members of the Community and Regional Affairs Committee. The primary concern was that the legislation be broad enough to permit loans to mitigate other serious indoor air pollutants in addition to radon.

The draft CS renames the "Radon Mitigation Revolving Loan Fund" the "Indoor Air Quality Revolving Loan Fund". Section 44.47.658 on page two has been expanded to allow the department to make loans for "other indoor air pollutants in the homeowner's residence if the department identifies them as priorities."

My office has investigated the other indoor air pollutants which may present a health risk to Alaskans. The EPA has guidelines for ambient, or outside, air quality. The state and federal Occupational Safety and Health Administrations (OSHA) have set personal exposure limits for approximately 400 contaminants in the workplace. These include methane, formaldehyde, carbon monoxide, and asbestos, but not radon. In its inspections, the state OSHA office has found no office situations exceeding the legal exposure limits.

The CS would permit the loan program to adapt to new discoveries about air pollutants and mitigation techniques. However, I believe radon should remain the primary focus of the loan fund for several reasons. We know that a serious radon problem exists in Alaska. At this time radon is the worst residential air pollutant in terms of numbers of Alaskans facing a significant health risk. The technology exists to reduce radon levels in homes. Finally, radon contamination results from the geological characteristics of the land rather than objects brought into the home.

I would appreciate a hearing for HB 519 and HB 520 at your earliest convenience.

(1,29) HB519

5-1651L
Chenoweth
3/31/88

Original sponsors: Davis, Koponen and Ulmer

IN THE HOUSE

CS FOR HOUSE BILL NO. 519 ( )

IN THE LEGISLATURE OF THE STATE OF ALASKA

FIFTEENTH LEGISLATURE - SECOND SESSION

A BILL

For an Act entitled: "An Act establishing a revolving loan fund to mitigate radon and indoor air pollutants [for radon mitigation]; and providing for an effective date."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. FINDINGS. The legislative finds that

(1) exposure to radon poses a serious threat to public health and is estimated to cause approximately 5,000 to 20,000 lung cancer deaths each year nationally;

(2) fourteen percent of the indoor radon measurements made by the state's divisions of geological and geophysical surveys and public health exceeded four picocuries, the level at which the Environmental Protection Agency recommends action be taken to reduce the level;

(3) there may be other indoor air pollutants that present serious health risks to Alaskans;

(4) environmental conditions in Alaska contribute to the health risk of indoor air pollution [radon] due to the long heating season, amount of time spent indoors, and pressure differentials caused by extreme indoor-outdoor temperature differentials;

(5) high levels of radon may decrease property values, making loans difficult to obtain and greatly hindering resale;

(6) techniques such as vapor barriers, air-to-air heat exchangers, and certain house pressurization strategies may be used to mitigate radon in homes;

(7) many Alaskans do not have the financial resources to install

mitigation systems to reduce the amount of radon and other indoor air pollutants in their homes; and

(8) state response to the health threat posed by [radon] indoor air pollution is essential and should continue at existing or expanded levels.

* Sec. 2. AS 44.47 is amended by adding new sections to read:

ARTICLE 11A. [Radon Mitigation] INDOOR AIR QUALITY REVOLVING LOAN FUND.

Sec. 44.47.650. [Radon Mitigation] INDOOR AIR QUALITY REVOLVING LOAN FUND. There is created in the Department of Community and Regional Affairs the [radon mitigation] indoor air quality revolving loan fund to carry out the purposes of AS 44.47.650 - 44.47.658. The fund may not be used for any other purpose.

Sec. 44.47.652. POWERS AND DUTIES OF THE DEPARTMENT IN ADMINISTERING THE FUND. (a) The department may

(1) make loans to homeowners to mitigate the effects of

(A) radon on property used as the homeowner's residence;

(B) other indoor air pollutants in the homeowner's residence if the department identifies them as priorities;

(2) adopt regulations necessary to carry out the provisions of AS 44.47.650 - 44.47.658.

(b) The department shall

(1) determine by regulation eligibility for loans based on a measurement of air quality within the borrower's residence; eligibility must be established based on a sliding scale that inversely relates the minimum measurement level to qualify for a loan to the length of the time period during which the air quality measurement was taken;

(2) develop other eligibility standards for loans;

(3) adopt guidelines for the determination of loan terms.

(c) The department shall dispose of property acquired through default or foreclosure of a loan made under AS 44.47.650 - 44.47.658. Disposal shall be made in a manner that serves the best interests of the state, and may include the amortization of payments over a period of years.

Sec. 44.47.654. LOAN TERMS AND PAYMENTS. (a) A loan made by the department under AS 44.47.650 - 44.47.658 may not exceed $10,000.

(b) The duration for repayment of a loan may not exceed 10 years.

(c) The interest rate on a loan made by the department under AS 44.47.650 - 44.47.658 is the annual rate charged member banks for advances by the 12th Federal Reserve District on the day the loan is made.

(d) All principal and interest payments on loans under AS 44.-47.650 - 44.47.658 shall be paid into the [radon mitigation] indoor air quality revolving loan fund.

Sec. 44.47.656. ELIGIBILITY FOR LOANS. A homeowner is eligible for a loan under AS 44.47.650 - 44.47.658 if

(1) a measurement of [radon] air pollutants in the homeowner's residence exceeded the level determined by program regulation under AS 44.47.652(b)(1);

(2) the homeowner has applied for a loan to mitigate the effects of [radon] indoor air pollution from a state chartered or federally chartered lending institution, and the application has been rejected;

(3) the homeowner submits to the department a plan for the use of the loan funds that is approved by the commissioner; and

(4) the applicant meets additional eligibility standards established by the department under AS 44.47.652.

Sec. 44.47.658. SPECIAL ACCOUNT ESTABLISHED. (a) There is

[radon mitigation]

established as a special account within the indoor air quality revolving loan fund the foreclosure expense account. This account is established as a reserve from fund equity.

(b) The commissioner may expend money credited to the foreclosure expense account when necessary to protect the state's security interest in collateral on loans made under AS 44.47.650 - 44.47.658 or to defray expenses incurred during foreclosure proceedings after a default by an obligor.

* Sec. 3. This Act takes effect July 1, 1988.

OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

THE SEAL OF THE STATE OF ALASKA

OCCUPATIONAL SAFETY AND HEALTH STANDARDS

ALASKA DEPARTMENT OF LABOR
Division of Labor Standards and Safety

JIM SAMPSON, COMMISSIONER   STEVE COWPER, GOVERNOR

STEVE COWPER
Governor of Alaska

JIM SAMPSON
COMMISSIONER, DEPARTMENT OF LABOR

DIVISION OF LABOR STANDARDS AND SAFETY

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The standards prescribed in this subchapter are effective as of June 30, 1973, as amended October 14, 1987. Alaska safety codes and standards apply to all places of employment. Information relative to the safety codes will be furnished by the above offices.

ALASKA DEPARTMENT OF LABOR

Section 18.60.010 of the Alaska Statutes designates the Alaska Department of Labor as the agency responsible for developing and administering an occupational safety and health program for the State of Alaska. To carry out this responsibility, AS 18.60.055 established the Division of Labor Standards and Safety.

The division is charged with the responsibility and has the authority to:

Enforce all laws and lawful orders requiring work and work places to be safe and healthful;

Investigate disabling or fatal occupational injuries and illnesses;

Inspect work places to determine if conditions are safe and healthful;

Develop occupational safety and health standards which, after adoption, have the effect of law; and

Establish special orders, or rules and regulations to cover a specific place of employment or process of work.

A variance from an occupational safety and health standard adopted by the department may be granted by the Commissioner of Labor as provided by AS 18.60.077, AS 18.60.081 and regulations promulgated pursuant thereto.

The safety and health standards prescribed in Subchapter 04, Occupational Health and Environmental Control Code, are adopted by reference in Title 8 of the Alaska Administrative Code and are effective as of June 30, 1973, as amended October 14, 1987.

Jim Sampson
Commissioner of Labor

Contents

SUBCHAPTER 4 – OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

ARTICLE 1 – OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL

04.0101 Air Contaminants. An employee's exposure to any material listed in Table 1–1, 1–2, or 1–3 of this section shall be limited in accordance with the requirements of the following paragraphs of 04.0101

(a) Table 1–1

(1) Materials with names preceded by 'C' ––Ceiling values. An employee's exposure to any material in Table 1-1, the name of which is preceded by a "C" (e.g. C Boron trifluoride), shall at no time exceed the ceiling value given for that material in the table

(2) Other materials ––8-hour time weighted averages. An employee's exposure to any material in Table 1–1, the name of which is not preceded by "C", in any 8-hour work shift of a 40–hour work week, shall not exceed the 8 hour time weighted average given for that material in the table

(b) Table 1–2.

(1) Eight–hour time weighted averages. An employee's exposure to any material listed in Table 1–2, in any 8–hour work shift of a 40–hour work week, shall not exceed the 8–hour time weighted average limit given for that material in the table.

(2) Acceptable ceiling concentrations. An employee's exposure to a material listed in Table 1–2 shall not exceed at any time during an 8–hour shift the acceptable ceiling concentration limit given for the material in the table, except for a time period up to a concentration not exceeding the maximum duration and concentration allowed in the column under "acceptable maximum peak above the acceptable ceiling concentration for an 8–hour shift."

(3) Example. During an 8–hour work shift, an employee may be exposed to a concentration of Benzene above 25 p.p.m. (but never above 50 p.p.m.) only for a maximum period of 10 minutes. Such exposure must be compensated by exposures to concentrations less than 10 p.p.m. so that the cumulative exposure for the entire 8–hour work shift does not exceed a weighted average of 10 p.p.m.

(c) Table 1–3. An employee's exposure to any material listed in Table 1–3, in any 8–hour work shift of a 40–hour work week, shall not exceed the 8–hour time weighted average limit given for that material in the table.

(d) Computation formulae.

(1) The cumulative exposure for an 8–hour work shift shall be computed as follows

$$E = \frac{C_aT_a + C_bT_b + \ldots\ldots C_nT_n}{8}$$

Where:

E is the equivalent exposure for the working shift,

C is the concentration during any period of time where the concentration remains constant,

T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average limit in Table 1–1, 1–2, or 1–3 for the material involved.

(2) To illustrate the formula prescribed in 04.0101(d)(1), note that isoamyl acetate has an 8–hour time weighted average limit of 100 p.p.m. (Table 1–1). Assume that an employee is subject to the following exposure

Two hours exposure at 150 p.p.m
Two hours exposure at 75 p.p.m.
Four hours exposure at 50 p.p.m.

Substituting this information in the formula, we have

$$\frac{2 \times 150 + 2 \times 75 + 4 \times 50}{8} = 81.25 \text{ p.p.m.}$$

Since 81.25 p.p.m. is less than 100, the 8-hour time weighted average limit, the exposure is acceptable.

(3) In c... ixture of air contaminants, an employer shall compute the equiva... ure as follows

$$E_m = \frac{C_1}{L_1} + \frac{C_2}{L_2} + \ldots \frac{C_n}{L_n}$$

Where:

E_m is the equivalent exposure for the mixture,

C is the concentration of a particular contaminant,

L is the exposure limit for that contaminant, from Table 1–1, 1–2, or 1–3.

The value of E_m shall not exceed unity (1)

(4) To illustrate the formula prescribed in 04.0101(d)(3), consider the following exposures:

Material	Actual concentration of 8–hour exposure	8-hour time weighted average exposure limit
Acetone (Table 1–1)	500 p.p.m	1,000 p.p.m
2-Butanone (Table 1–1)	45 p.p.m.	200 p.p.m
Toluene (Table 1–2)	40 p.p.m	200 p.p.m

Substituting in the formula, we have:

$$E_m = \frac{500}{1{,}000} + \frac{45}{200} + \frac{40}{200}$$

$$E_m = 0.500 + 0.225 + 0.200$$

$$E_m = 0.925$$

Since E_m is less than unity (1), the exposure combination is within acceptable limits.

(e) To achieve compliance with 04.0101 (a) through (d), administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in 04.0101. Any equipment or technical measure used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with 01.0403.

(f) Whenever percussion drilling is performed, the drilling apparatus shall be provided with engineering controls which will suppress the drilling dust. This may be accomplished by methods known as "damp drilling," "modified wet drilling," "detergent drilling," "dust extraction" or any other means of dust control which produces comparable results.

TABLE 1-1

Substance	p.p.m.[a]	mg./M3 [b]
Acetaldehyde	200	360
Acetic acid	10	25
Acetic anhydride	5	20
Acetone	1,000	2,400
Acetonitrile	40	70
Acetylene dichloride, see 1, 2-Dichloroethylene		
Acetylene tetrabromide	1	14
Acrolein	0.1	0.25
Acrylamide –Skin		.3
Aldrin –Skin		0.25
Allyl alcohol –Skin	2	5
Allyl chloride	1	3
**C Allylglycidyl ether (AGE)	10	45
Allyl propyl disulfide	2	12
2-Aminoethanol, see Ethanolamine		
2-Aminopyridine	0.5	2
**Ammonia	50	35
Ammonium sulfamate (Ammate)		15
n-Amyl acetate	100	525
sec-Amyl acetate	125	650
Aniline –Skin	5	19
Anisidine (o, p-isomers) –Skin		0.5
Antimony and compounds (as Sb)		0.5
ANTU (alpha naphthyl thiourea)		0.3
Arsine	0.05	0.2
Azinphos-methyl –Skin		0.2
Barium (soluble compounds)		0.5
p-Benzoquinone, see Quinone		
Benzoyl peroxide		5
Benzyl chloride	1	5
Biphenyl, see Diphenyl		
Bisphenol A, see Diglycidyl ether		
Boron oxide		15
C Boron trifluoride	1	3
Bromine	0.1	0.7
Bromoform –Skin	0.5	5
Butadiene (1, 3-butadiene)	1,000	2,200
Butanethiol, see Butyl mercaptan		
2-Butanone	200	590
2-Butoxy ethanol (Butyl Cellosolve) –Skin	50	240
Butyl acetate (n-butyl acetate)	150	710

Substance	p.p.m.[a]	mg./M3 [b]
sec-Butyl acetate	200	950
tert-Butyl acetate	200	950
Butyl alcohol	100	300
sec-Butyl alcohol	150	450
tert-Butyl alcohol	100	300
C Butylamine –Skin	5	15
C tert-Butyl chromate (as CrO_3) –Skin		0.1
n-Butyl glycidyl ether (BGE)	50	270
*Butyl mercaptan	10	35
p-tert-Butyltoluene	10	60
Calcium oxide		5
Camphor		2
Carbaryl (Sevin ®)		5
Carbon black		3.5
Carbon dioxide	5,0[illegible]	9,000
Carbon monoxide	[illegible]	55
Chlordane –Skin		0.5
Chlorinated camphene –Skin		0.5
Chlorinated diphenyl oxide		0.5
C Chlorine	1	3
Chlorine dioxide	0.1	0.3
C Chlorine trifluoride	0.1	0.4
C Chloroacetaldehyde	1	3
α-Chloroacetophenone (phenacylchloride)	0.05	0.3
Chlorobenzene (monochlorobenzene)	75	350
o-Chlorobenzylidene malononitrile (OCBM)	0.05	0.4
Chlorobromomethane	200	1,050
2-Chloro-1, 3-butadiene, see Chloroprene		
Chlorodiphenyl (42% Chlorine) –Skin		1
Chlorodiphenyl (54% Chlorine) –Skin		0.5
1-Chloro, 2, 3-epoxypropane, see Epichlorhydrin		
2-Chloroethanol, see Ethylene chlorohydrin		
Chloroethylene, see Vinyl chloride		
C Chloroform (trichloromethane)	50	240
1-Chloro-1-nitropropane	20	100
Chloropicrin	0.1	0.7
Chloroprene (2-chloro-1, 3-butadiene) –Skin	25	90
Chromium, sol. chromic, chromous salts as Cr		0.5
Metal and insol. salts		1
Coal tar pitch volatiles (benzene soluble fraction) anthracene, BaP, phenanthrene, acridine, chrysene, pyrene		0.2
Cobalt, metal fume and dust		0.1
Copper fume		0.1
Dusts and mists		1
Cotton dust (raw)		1
Crag ® herbicide		15
Cresol (all isomers) –Skin	5	22
Crotonaldehyde	2	6
Cumene –Skin	50	245
Cyanide (as CN) –Skin		5
Cyclohexane	300	1,050
Cyclohexanol	50	200
Cyclohexanone	50	200
Cyclohexene	300	1,015
Cyclopentadiene	75	200
2, 4-D		10
DDT –Skin		1
DDVP, Skin		
Decaborane –Skin	0.05	0.3
Demeton ® –Skin		0.1
Dibutyl Phosphate	1	5

Substance	p.p.m.[a]	mg./M3 [b]
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240
1, 2-diaminoethane, see Ethylenediamine		
Diazomethane	0.2	0.4
Diborane	0.1	0.1
Dibutylphthalate		5
C o-Dichlorobenzene	50	300
p-Dichlorobenzene	75	450
Dichlorodifluoromethane	1,000	4,950
1, 3-Dichloro-5, 5-dimethyl hydantoin		0.2
1, 1-Dichloroethane	100	400
1, 2-Dichloroethylene	200	790
C Dichloroethyl ether –Skin	15	90
Dichloromethane, see Methylenechloride		
Dichloromonofluoromethane	1,000	4,200
C 1, 1-Dichloro-1-nitroethane	10	60
1, 2-Dichloropropane, see Propylenedichloride		
Dichlorotetrafluoroethane	1,000	7,000
Dichlorvos (DDVP) –Skin		1
Dieldrin –Skin		0.25
Diethylamine	25	75
Diethylamino ethanol –Skin	10	50
Diethylether, see Ethyl ether		
Difluorodibromomethane	100	860
C Diglycidyl ether (DGE)	0.5	2.8
Dihydroxybenzene, see Hydroquinone		
Diisobutyl ketone	50	290
Diisopropylamine –Skin	5	20
Dimethoxymethane, see Methylal		
Dimethyl acetamide –Skin	10	35
Dimethylamine	10	18
Dimethylaminobenzene, see Xylidene		
Dimethylaniline (N-dimethylaniline) –Skin	5	25
Dimethylbenzene, see Xylene		
Dimethyl 1, 2-dibromo-2, 2-dichloroethyl phosphate, (Dibrom)		3
Dimethylformamide –Skin	10	30
2, 6-Dimethylheptanone, see Diisobutyl ketone		
1, 1-Dimethylhydrazine –Skin	0.5	1
Dimethylphthalate		5
Dimethylsulfate –Skin	1	5
Dinitrobenzene (all isomers) –Skin		1
Dinitro-o-cresol –Skin		0.2
Dinitrotoluene –Skin		1.5
Dioxane (Diethylene dioxide) –Skin	100	360
Diphenyl	0.2	1
Diphenylmethane diisocyanate (see Methylene bisphenyl isocyanate (MDI))		
Dipropylene glycol methyl ether –Skin	100	600
Di-sec, octyl phthalate (Di-2-ethylhexylphthalate)		5
Endrin –Skin		0.1
Epichlorhydrin –Skin	5	19
EPN –Skin		0.5
1, 2-Epoxypropane, see Propyleneoxide		
2, 3-Epoxy-1-propanol, see Glycidol		
Ethanethiol, see Ethylmercaptan		
Ethanolamine	3	6
2-Ethoxyethanol –Skin	200	740
2-Ethoxyethylacetate (Cellosolve acetate) –Skin	100	540
Ethyl acetate	400	1,400
Ethyl acrylate –Skin	25	100
Ethyl alcohol (ethanol)	1,000	1,900
Ethylamine	10	18

Substance	p.p.m.[a]	mg./M3 [b]
Ethyl sec-amyl ketone (5-methyl-3-heptanone)	25	130
Ethyl benzene	100	435
Ethyl bromide	200	890
Ethyl butyl ketone (3-Heptanone)	50	230
Ethyl chloride	1,000	2,600
Ethyl ether	400	1,200
Ethyl formate	100	300
C Ethyl mercaptan	10	25
Ethyl silicate	100	850
Ethylene chlorohydrin –Skin	5	16
Ethylenediamine	10	25
C Ethylene glycol dinitrate and/or Nitroglycerin –Skin	0.2[d]	1
Ethylene glycol monomethyl ether acetate, see Methyl cellosolve acetate		
Ethylene imine –Skin	0.5	1
Ethylidine chloride, see 1, 1-Dichloroethane		
N-Ethylmorpholine –Skin	20	94
Ferbam		15
Ferrovanadium dust		1
Fluoride (as F)		2.5
Fluorine	0.1	0.2
Fluorotrichloromethane	1,000	5,600
Formic acid	5	9
Furfural –Skin	5	20
Furfuryl alcohol	50	200
Glycidol (2, 3-Epoxy-1-propanol)	50	150
Glycol monoethyl ether, see 2-Ethoxyethanol		
Guthion, ® see Azinphosmethyl		
Hafnium		0.5
Heptachlor –Skin		0.5
Heptane (n-heptane)	500	2,000
Hexachloroethane –Skin	1	10
Hexachloronaphthalene –Skin		0.2
Hexane (n-hexane)	500	1,800
2-Hexanone	100	410
Hexone (methyl isobutyl ketone)	100	410
sec-Hexyl acetate	50	300
Hydrazine –Skin	1	1.3
Hydrogen bromide	3	10
C Hydrogen chloride	5	7
Hydrogen cyanide –Skin	10	11
Hydrogen peroxide (90%)	1	1.4
Hydrogen selenide	0.05	0.2
Hydroquinone		2
C Iodine	0.1	1
Iron oxide fume		10
Isoamyl acetate	100	525
Isoamyl alcohol	100	360
Isobutyl acetate	150	700
Isobutyl alcohol	100	300
Isophorone	25	140
Isopropyl acetate	250	950
Isopropyl alcohol	400	980

Substance	p.p.m.[a]	mg./M3 b
Isopropylamine	5	12
Isopropylether	500	2,100
Isopropyl glycidyl ether (IGE)	50	240
Ketene	0.5	0.9
Lead arsenate		0.15
Lindane - Skin		0.5
Lithium hydride		0.025
L.P.G. (Liquified petroleum gas)	1,000	1,800
Magnesium oxide fume		15
Malathion - Skin		15
Maleic anhydride	0.25	1
C Manganese		5
Mesityl oxide	25	100
Methanethiol, see Methyl mercaptan		
Methoxychlor		15
2-Methoxyethanol, see Methyl cellosolve		
Methyl acetate	200	610
Methyl acetylene (propyne)	1,000	1,650
Methyl acetylene-propadiene mixture (MAPP)	1,000	1,800
Methyl acrylate -Skin	10	35
Methylal (dimethoxymethane)	1,000	3,100
Methyl alcohol (methanol)	200	260
Methylamine	10	12
Methyl amyl alcohol, see Methyl isobutyl carbinol		
Methyl (n-amyl) ketone (2-Heptanone)	100	465
C Methyl bromide -Skin	20	80
Methyl butyl ketone, see 2-Hexanone		
Methyl cellosolve -Skin	25	80
Methyl cellosolve acetate -Skin	25	120
Methyl chloroform	350	1,900
Methylcyclohexane	500	2,000
Methylcyclohexanol	100	470
o-Methylcyclohexanone -Skin	100	460
Methyl ethyl ketone (MEK), see 2-Butanone		
Methyl formate	100	250
Methyl iodide -Skin	5	28
Methyl isobutyl carbinol -Skin	25	100
Methyl isobutyl ketone, see Hexone		
Methyl isocyanate -Skin	0.02	0.05
C Methyl mercaptan	10	20
Methyl methacrylate	100	410
Methyl propyl ketone, see 2-Pentanone		
C α Methyl styrene	100	480
C Methylene bisphenyl isocyanate (MDI)	0.02	0.2
Molybdenum:		
Soluble compounds		5
Insoluble compounds		15
Monomethyl aniline - Skin	2	9
C Monomethyl hydrazine -Skin	0.2	0.35
Morpholine -Skin	20	70
Naphtha (coaltar)	100	400
Naphtalene	10	50
Nickel carbonyl	0.001	0.007
Nickel, metal and soluble compounds, as Ni		1
Nicotine -Skin		0.5
Nitric acid	2	5
Nitric oxide	25	30
p-Nitroaniline -Skin	1	6
Nitrobenzene -Skin	1	5
p-Nitrochlorobenzene - Skin		1

Substance	p.p.m.[a]	mg./M3 b
Nitroethane	100	310
C Nitrogen dioxide	5	9
Nitrogen trifluoride	10	29
C Nitroglycerin -Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
Nitrotoluene, -Skin	5	30
Nitrotrichloromethane, see Chloropicrin		
Octachloronaphthalene -Skin		0.1
Octane	500	2,350
Oil mist, mineral		5[e]
Osmium tetroxide		0.002
Oxalic Acid		1
Oxygen diflouride	0.05	0.1
Ozone	0.1	0.2
Paraquat -Skin		0.5
Parathion -Skin		0.1
Pentaborane	0.005	0.01
Pentachloronaphthalene -Skin		0.5
Pentachlorophenol -Skin		0.5
*Pentane	1,000	2,950
2-Pentanone	200	700
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.5
Petroleum distillates (naphtha)	500	2,000
Phenol -Skin	5	19
p-Phenylene diamine -Skin		0.1
Phenyl ether (vapor)	1	7
Phenyl ether-biphenyl mixture (vapor)	1	7
Phenylethylene, see Styrene		
Phenylglycidyl ether (PGE)	10	60
Phenylhydrazine -Skin	5	22
Phosdrin (Mevinphos ®) -Skin		0.1
Phosgene (carbonyl chloride)	0.1	0.4
Phosphine	0.3	0.4
Phosphoric acid		1
Phosphorus (yellow)		0.1
Phosphorus pentachloride		1
Phosphorus pentasulfide		1
Phosphorus trichloride	0.5	3
Phthalic anhydride	2	12
Picric acid - Skin		0.1
Pival Ⓣ (2-Pivalyl-1, 3-indandione)		0.1
Platinum (Soluble Salts) as Pt		0.002
Propane	1,000	1,800
n-Propyl acetate	200	840
Propyl alcohol	200	500
n-Propyl nitrate	25	110
Propylene dichloride	75	350
Propylene imine - Skin	2	5
Propylene oxide	100	240
Propyne, see Methylacetylene		
Pyrethrum		5
Pyridine	5	15
Quinone	0.1	0.4
Rhodium, Metal fume and dusts,		
as Rh		0.1
Soluble salts		0.001

Substance	p.p.m.[a]	mg./M3 [b]
Ronnel		15
Rotenone (commercial)		5
Selenium compounds (as Se)		0.2
Selenium hexafluoride	0.05	0.4
Silver, metal and soluble compounds		0.01
Sodium fluoroacetate (1080) –Skin		0.05
Sodium Hydroxide		2
Stibine	0.1	0.5
Stoddard solvent	500	2,900
Strychnine		0.15
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid		1
Sulfur monochloride	1	6
Sulfur pentafluoride	0.025	0.25
Sulfuryl fluoride	5	20
Systox, see Demeton ®		
2, 4, 5T		10
Tantalum		5
TEDP –Skin		0.2
Tellurium		0.1
Tellurium hexafluoride	0.02	0.2
TEPP –Skin		0.05
C Terphenyls	1	9
1, 1, 1, 2-Tetrachloro-2, 2-difluoroethane	500	4,170
1, 1, 2, 2-Tetrachloro-1, 2-difluoroethane	500	4,170
1, 1, 2, 2-Tetrachloroethane –Skin	5	35
Tetrachloromethane, see Carbon tetrachloride		
Tetrachloronaphthalene –Skin		2
Tetraethyl lead (as Pb) –Skin		0.075
Tetrahydrofuran	200	590
Tetramethyl lead (as Pb) –Skin		0.075
Tetramethyl succinonitrile –Skin	0.5	3
Tetranitromethane	1	8
Tetryl (2, 4, 6-trinitrophenyl-methylnitramine) –Skin		1.5
Thallium (soluble compounds) –Skin as Tl		0.1
Thiram		5
Tin (inorganic compounds, except oxides)		2
Tin (organic compounds)		0.1
Titanium dioxide		15
C Toluene-2, 4-diisocyanate	0.02	0.14
o-Toluidine –Skin	5	22
Toxaphene, see Chlorinated camphene		
Tributyl phosphate		5
1, 1, 1-Trichloroethane, see Methyl chloroform		
1, 1, 2-Trichloroethane Skin	10	45
Trichloromethane, see Chloroform		
Trichloronaphthalene –Skin		5
1, 2, 3-Trichloropropane	50	300
1, 1, 2 Trichloro 1, 2, 2-trifluoroethane	1,000	7,600
Triethylamine	25	100
Trifluoromonobromomethane	1,000	6,100
2, 4, 6-Trinitrophenol, see Picric acid		
2, 4, 6-Trinitrophenylmethylnitramine, see Tetryl		
Trinitrotoluene –Skin		1.5
Triorthocresyl phosphate		0.1
Triphenyl phosphate		3
Turpentine	100	560
Uranium (soluble compounds)		0.05
Uranium (insoluble compounds)		0.25
C Vanadium:		
V_2O_5 dust		0.5
V_2O_5 fume		0.1
Vinyl benzene, see Styrene		
Vinylcyanide, see Acrylonitrile		
Vinyl toluene	100	480
Warfarin		0.1
Xylene (xylol)	100	435
Xylidine –Skin	5	25
Yttrium		1
Zinc chloride fume		1
Zinc oxide fume		5
Zirconium compounds (as Zr)		5

*1970 Addition

[a]Parts of vapor or gas per million parts of contaminated air by volume at 25° C. and 760 mm. Hg pressure.

[b]Approximate milligrams of particulate per cubic meter of air.

(No footnote "c" is used to avoid confusion with ceiling value notations.)

[d]An atmospheric concentration of not more than 0.02 p.p.m., or personal protection may be necessary to avoid headache.

[e]As sampled by method that does not collect vapor

[f]For control of general room air, biologic monitoring is essential for personnel control.

TABLE 1–2

Material	8–hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8–hour shift	
			Concentration	Maximum duration
Benzene (Z37.4–1969)	10 p.p.m.	25 p.p.m.	50 p.p.m.	10 minutes
Beryllium and beryllium compounds (Z37.29–1970)	2 µg./M3	5 µg./M3	25 µg./M3	30 minutes
Cadmium fume (Z37.5–1970)	0.1 mg./M3	3 mg./M3	....	....
Cadmium dust (Z37.5–1970)	0.2 mg./M3	0.6 mg./M3	....	....
Carbon disulfide (Z37.3–1968)	20 p.p.m.	30 p.p.m.	100 p.p.m.	....do ...
Carbon tetrachloride (Z37 17–1967)	10 p.p.m.	25 p.p.m.	200 p.p.m.	5 minutes in any 4 hours
Chromic acid and chromates (Z37.7–1971)	....	do[3]	....	....
Ethylene dibromide (Z37.31–1970)	20 p.p.m.	30 p.p.m.	50 p.p.m.	5 minutes
Ethylene dichloride (Z37.21–1969)	50 p.p.m.	100 p.p.m.	200 p.p.m.	5 minutes in any 3 hours
Formaldehyde (Z37.16–1967)	3 p.p.m.	5 p.p.m.	10 p.p.m.	30 minutes
Hydrogen fluoride (Z37.28–1969)	3 p.p.m.	....	....	....
Fluoride as dust (Z37.28–1969)	2.5 mg./M3	....	....	....
Mercury (Z37.8–1971)	....	1 mg./10 M3	....	....
Methyl chloride (Z37.18–1969)	100 p.p.m.	200 p.p.m.	300 p.p.m.	5 minutes in any 3 hours
Methylene chloride (Z37.3–1969)	500 p.p.m.	1,000 p.p.m.	2,000 p.p.m.	5 minutes in any 2 hours
Organo (alkyl) mercury (Z37.30–1969)	0.01 mg./M3	0.04 mg./M3	....	....
Styrene (Z37.15–1969)	100 p.p.m.	200 p.p.m.	600 p.p.m.	5 minutes in any 3 hours
Trichloroethylene (Z37.19–1967)	100 p.p.m.	200 p.p.m.	300 p.p.m.	5 minutes in any 2 hours
Tetrachloroethylene (Z37.22–1967)	100 p.p.m.	200 p.p.m.	300 p.p.m.	5 minutes in any 3 hours
Toluene (Z37.12–1967)	200 p.p.m.	300 p.p.m.	500 p.p.m.	10 minutes
Hydrogen sulfide (Z37.2–1966)	....	20 p.p.m.	50 p.p.m.	10 minutes once only only if no other measurable exposure occurs.

TABLE 1–3 Mineral Dusts

Substance	Mppcf[g]	Mg./M3
Silica:		
Crystalline:		
Quartz (respirable)	$\frac{250^h}{\%SiO_2 + 5}$	$\frac{10mg./M^3}{\%SiO_2 + 2}$ m
Quartz (total dust)	....	$\frac{30mg./M^3}{\%SiO_2 + 2}$
Cristobalite: Use ½ the value calculated from the count or mass formulae for quartz		
Tridymite: Use ½ the value calculated from the formulae for quartz		
Amorphous, including natural diatomaceous earth	20	$\frac{80mg./M^3}{\%SiO_2}$
Silicates (less than 1% crystalline silica):		
Mica	20	
Soapstone	20	
Talc (non-asbestos-form)	20[n]	
Talc (fibrous). Use asbestos limit	....	
Tremolite (see talc, fibrous)	....	
Portland cement	50	
Graphite (natural)	15	
Coal dust (respirable fraction less than 5% SiO_2)	....	2.4mg./M3 or
For more than 5% SiO_2	....	$\frac{10mg\ M^3}{\%SiO_2 + 2}$
Inert or Nuisance Dust:		
Respirable fraction	15	5mg./M3
Total dust	5	15mg./M3

Note: Conversion factors –
mppcf X 35.3 = million particles per cubic meter
= particles per c.c.

[g] Millions of particles per cubic foot of air, based on impinger samples counted by light-field technics.

[h] The percentage of crystalline silica in the formula is the amount determined from air-borne samples except in those instances in which other methods have been shown to be applicable.

Table 1–3 Mineral Dusts (continued)

[m]Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

[n] Containing <1% quartz; if 1% quartz, use quartz limit.

Aerodynamic diameter (unit density sphere)	Percent passing selector
2	90
2 5	75
3 5	50
5 0	25
10	0

The measurements under this note refer to the use of an ACE instrument. The respirable fraction of coal dust is determined with a MRE; the figure corresponding to that of 2.4 M_g/M^3 in the table for coal dust is 4.5 M_g/M^3.

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INDOOR AIR QUALITY

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INDOOR AIR QUALITY

This paper, presented for Round Table discussion to the NATO Committee on the Challenges of Modern Society, addresses the status of Indoor Air Quality Policy and Research in the United States. It briefly reviews the issue, characterizes the nature of the problem, and discusses potential mitigation options. It also presents a case study of the United States' effort on radon, summarizes research efforts, and reviews the development of indoor air policy for the United States.

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I. BACKGROUND AND HISTORICAL PERSPECTIVE

Over the past several decades, efforts to control air pollution in the United States have focused on outdoor ambient air and the industrial work environment. The quality of indoor air, including the air in homes, offices, and other commercial buildings, was not originally considered to be an issue requiring national attention.

In the early 1970s, however, indoor air pollution received increased public attention when the Federal government instituted energy conservation measures that led to the use of newer insulating materials to "tighten" buildings and the design of new buildings with significantly reduced intake of outdoor air. During this time, formaldehyde was identified as the cause of acute irritant reactions, primarily eye and nose irritation and respiratory distress, in individuals living in homes insulated with urea-formaldehyde foam insulation, and mobile homes constructed with large quantities of particle board and plywood.

The formaldehyde issue led to additional research to assess the types and quantities of air pollutants found in various indoor environments, all of which came to the same conclusion: for certain pollutant types, concentrations were often much higher indoors than they were outdoors. Furthermore, when high concentrations were coupled with the fact that most people spend more of their time indoors than outdoors, the risk to human health from indoor air pollution was shown to be greater than previously thought. Certain particularly susceptible people -- children, persons with lung diseases or impaired immune systems, and the elderly -- may be at considerable risk.

As the general problem of indoor air pollution was drawing more nationwide attention as a potential public health problem, a particular type of indoor air pollution, radon, was causing immediate concern in certain parts of the country. Public concern over the potential health effects of radon exposure, and the realization that such exposures could be occurring over wide areas, led to the establishment of EPA's Radon Action Program in 1985. Preliminary results of a recent 10-state survey under this program indicate the potential magnitude of the problem. The survey showed 21 percent of the 11,600 homes studied had elevated radon levels, defined by EPA as levels above 4 picocuries per liter of air.

Radon is only one of the indoor air problems. Occupants of particularly modern, energy-efficient buildings are experiencing acute health symptons that are caused by indoor air pollutants. Building-associated illnesses are becoming an increasing public health concern and have been observed in many types of buildings, including offices, schools, and health care facilities. As of early 1987, the National

Institute for Occupational Safety and Health, an agency of the Federal Government, had investigated over 450 outbreaks of building-associated illnesses and discomfort complaints. The magnitude of the problem is confirmed by environmental and health agencies in European countries and Canada, who report similar incidences.

Indoor air pollution has thus emerged as an international air quality issue. Several international conferences on indoor air quality have been held in recent years, the most recent being the Fourth International Conference on Indoor Air Quality and Climate held in August of this year in West Berlin. This conference was sponsored by the World Health Organization, the Commission of the European Communities, and the U.S. Environmental Protection Agency, as well as other organizations from the United States, West Germany, and Japan. It is important that the international nature of the indoor air quality problem lead to further international cooperation and information exchange aimed at finding solutions to indoor air quality problems.

II. CHARACTERIZATION OF INDOOR AIR POLLUTION

Microenvironments and Total Exposure

Assessment of total human exposure to environmental pollutants is an emerging science which focuses on the activities of populations and individuals that bring them into contact with pollutants. A major component of total exposure is total exposure to air pollutants. Total air exposure is the sum of pollutant exposures encountered in different air environments or spaces, integrated over some defined time period (e.g., day, year, lifetime). Indoor environments include residences, public and private buildings, and vehicles. The total air exposure concept is illustrated in Figure 1.

Pollutants and Pollutant Sources

Table 1 summarizes the major indoor pollutant categories and some of their possible sources. Most pollutants in most environments have multiple sources.

Concentrations and Exposures

A growing body of evidence indicates that exposure to air pollutants in indoor environments (e.g., the home, office building, school) can contribute significantly to total air exposure; in many cases, exposure levels in the indoor environment exceed outdoor exposure levels. High indoor exposure levels are the result of the elevated indoor pollutant concentrations and the fact that most people spend approximately 90 percent of their daily time in indoor environments. This is best illustrated by data from EPA's Total Exposure Assessment Methodology (TEAM) Studies, which analyzed total exposure to selected organic chemicals. Table 2 presents a summary of indoor/outdoor concentration ratios and estimated exposures for various volatile organic compounds measured in these studies.

Health Effects and Risks

The health effects that may result from exposure to chemicals that occur as indoor air pollutants include acute toxicity, noncarcinogenic chronic health effects, and cancer. Moreover, different types of health effects are associated with different indoor air pollutants. Chemical class-specific trends are evident. For example, particulates and some inorganic gases prima[illegible] impair respiratory function; some aldehydes cause eye and respira[illegible] irritation; and some halogenated hydrocarbons cause liver/kidney ca[illegible] and/or cancer. It is likely that some indoor

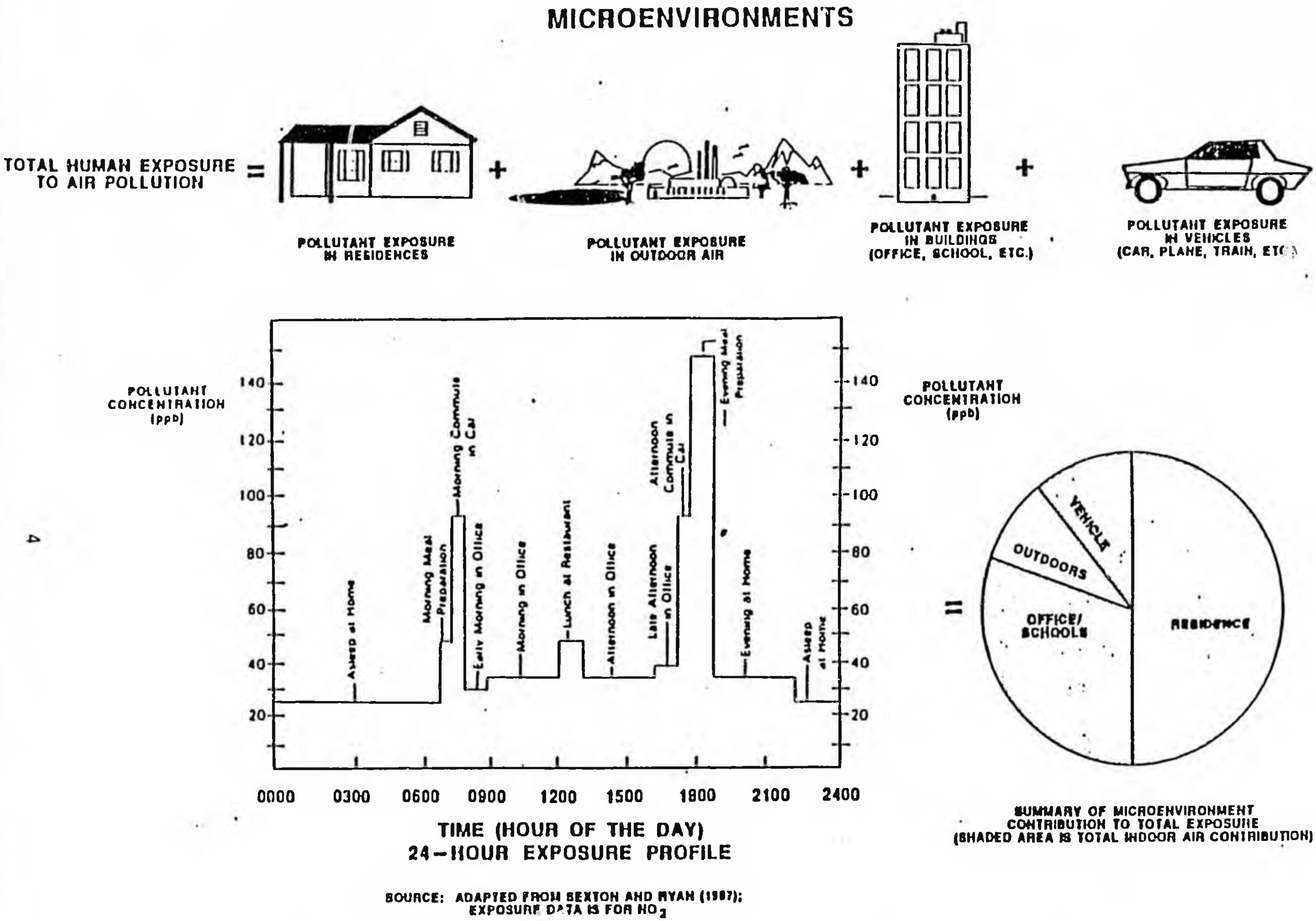

Figure 1. Representations of Microenvironment Contributions to Total Air Pollution Exposure.

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Table 1. Summary of Pollutant Categories and Subcategories and Potential Sources

Pollutant category/subcategory	Examples of Potential Sources
Inorganic gases (e.g., carbon dioxide, carbon monoxide, ozone, nitrogen monoxide)	Heating, ventilation and air conditioning (HVAC) systems Combustion appliances Tobacco Outdoor air Garages (vehicular exhaust) Human and animal origin (metabolism, respiration) Electrical equipment
Metals and other inorganics (e.g., lead, cadmium, phosphates)	HVAC systems Combustion appliances Tobacco Outdoor air Garages (vehicular exhaust) Paints and associated supplies Pesticides Building materials
Particulates/fibers	
- Biological origin (viable and nonviable) (e.g., pollen, bacteria, viruses)	HVAC systems (e.g., air conditioning reservoirs, filters, fan coils, ductwork, humidifiers) Human, animal, and plant origin Outdoor air
- Nonbiological origin (e.g., asbestos, dust)	Tobacco Building materials (insulation, wallboards) HVAC systems Combustion appliances Outdoor air Garages (vehicular exhaust) Cleaners and waxes Pesticides Paints and supplies Cosmetics and body care products Furnishings and apparel Activities associated with do-it-yourself projects and hobbies (fiberglass finishing, wood sanding)
Radioactive pollutants (e.g., radon)	Soils/rocks Building materials (brick, cement, stone) Drinking water (well water)

Table 1 (continued)

Pollutant category/subcategory	[illegible] sources
Volatile organic compounds (VOCs) (e.g., formaldehyde, benzene, methylene chloride)	Cleaners and waxes Paints and associated supplies Pesticides Adhesives Building materials (insulation, plywood, tiles) Furnishings and apparel (furniture, upholstery, carpets, clothing) Newspapers and printed material Tobacco Drinking water (aspirated, such as during showering) Automotive products Specialty chemicals associated with hobbies Cosmetics and body care products Garages (vehicular exhaust) Combustion appliances HVAC systems Science or laboratory chemicals (in schools) Art supplies (in schools) Office equipment (photocopiers) Outdoor air
Polynuclear aromatic hydrocarbons (PAHs) (e.g., benzo(a)pyrene, benzoanthracene)	Tobacco HVAC systems Combustion appliances Cleaners and waxes Garages (vehicular exhaust) Automotive products (oils, hydraulic fluid) Pesticides Paints and supplies Adhesives

Table 2 Comparison of Indoor/Outdoor (I/O) VOC Concentration Ratios and Exposure Estimates for VOCs from TEAM Study

Chemical	Measured I/O concentrations		Calculated annual exposure range (mg/yr)	
	Average I/O ratio	I/O range	Indoor	Outdoor
Chloroform	8	1 - 15	0.06 - 20	0.03 - 0.56
1,1,1-Trichloroethane	50	0.5 - 100	26 - 150	1.2 - 4.0
Benzene	20	--	26 - 89	1.5 - 15
Carbon tetrachloride	5.5	1 - 10	3.9 - 8.9	0.26 - 0.69
Trichloroethylene	4	3 - 5	1.5 - 16	0.05 - 1.2
Tetrachloroethylene	3.5	3 - 4	11 - 49	0.21 - 6.3
Styrene	8	--	4.2 - 17	0.20 - 3.6
m & p-Dichlorobenzene	9	8 - 10	3.1 - 25	0.21 - 1.5
Ethylbenzene	8.5	7 - 10	11 - 47	0.56 - 9.4
o - Xylene	8	6 - 10	12 - 58	0.33 - 11
m & p-Xylene	7	4 - 10	36 - 130	1.1 - 26

air pollutants may act cumulatively or synergistically to cause effects that the individual pollutants could not cause by themselves.

A number of known or suspected cancer-causing chemicals are present in indoor air (e.g., trichloroethylene, chlordane, formaldehyde, radon, tobacco smoke). Exposure to these and other indoor pollutants may result in significant risk. Total risks posed by exposure to indoor pollutants will likely exceed those posed by exposure via other environmental exposure pathways (e.g., outdoor air, drinking water). Radon alone is estimated to be responsible for from 5,000 to 20,000 lung cancer deaths per year. Published risk estimates of lung cancer deaths in nonsmokers exposed to environmental tobacco smoke range from 500 to 5,000 per year, with total mortality estimates ranging from 4,000 to 50,000 deaths per year.

Additional adverse health effects can result from exposure to microorganisms and other biological contaminants. These health effects are of three general categories: allergic reactions (e.g., asthma), infections (e.g., pneumonia), and fungal releases of chemical toxins (e.g., mycointoxication). Allergic reactions can be caused by a variety of agents such as pollen, fungi, animal dander, house dust mites, and insect products. Infectious diseases result from the airborne spread of bacteria and viruses. Building heating, ventilation, and air conditioning (HVAC) systems contribute to the movement of biological contaminants indoors and, when not properly maintained, can provide an environment for contaminant growth and dispersal. This is best demonstrated by the outbreak of "Legionnaire's Disease" among American Legion Society members following a convention in a Philadelphia Hotel in 1980.

Exposure to indoor air pollutants may also result in loss of productivity in the workplace. Even at low exposure levels, some indoor air pollutants, such as carbon monoxide and lead, are known to cause impairments in nervous system-muscle performance, decision-making, and tasks requiring concentration or neurophysiological function. Mixtures of chemicals (e.g., tobacco smoke) may also lead to loss of productivity. Another measure of loss of productivity is absenteeism from work. If workers are exposed to high enough levels of indoor air pollutants to cause overt illness ("sick building syndrome"), they may stay home more frequently because of the illness symptoms and, possibly, psychological aversion to returning to a work environment that caused such illnesses. Some of the most notable research concerning exposure to chemical mixtures and possible loss of worker productivity has been performed by Dr. Lars Mølhave of the University of Aarhus in Denmark.

Table 3 summarizes some of the health effects and risk issues concerning indoor air pollution.

Table 3. Summary of Issues - Indoor Air Health Effects and Risks

Issue area	Issue	Conclusions	Comments
Health effects	Overview	All major indoor air pollutant categories contain chemicals that cause adverse health effects.	Effects can include eye and respiratory tract irritation, respiratory impairment, neurotoxic effects, effects on major organs, effects on developing fetus, allergies, infectious disease(s), cancer.
	Cancer	More than a dozen known or suspected human carcinogens are known to be present in indoor air; radon and tobacco smoke in indoor air have been demonstrated to cause cancer based on epidemiological data.	Monitoring data are limited for many pollutants.
	Chronic effects	Most chronic effects data are from single-pollutant studies with animals or human volunteers. Studies confirm chronic effects for formaldehyde, pollen, nitrogen dioxide (NO_2), combustion particles, and tobacco smoke in actual indoor settings.	Many additional indoor pollutants are likely to be involved in chronic effects; most chronic effects focus on the respiratory tract
	Acute effects	Major target sites are the respiratory tract and central nervous system, although other sites (e.g., eye) can be involved	A collection of acute effects not associated with a specific disease is referred to as the Sick Building Syndrome [illegible]
	Synergistic effects	These are more than additive effects involving multiple pollutants and multiple exposure routes.	Synergistic effects are known to occur for [illegible] and aerosols, O_3 and aerosols, SO_2 and aerosols, radon and tobacco smoke, and PAH with other compounds.
	Effects of biological contaminants	These contaminants result in symptoms that range from hypersensitivity pneumonitis or other allergic resonses to infectious diseases.	Biological contamination includes bacteria, fungi, protozoa, or other products of biological origin.

Table 3. (Continued)

Issue area	Issue	Conclusions	Comments
Health effects (continued)	Loss of productivity	This result is potentially caused by pollutants in indoor air; may be measured as reduced performance and increased absenteeism.	
	Sensitive populations	On the order of 30% of the population exposed to indoor air pollutants may be particularly sensitive to pollutant effects.	
[illegible] Syndrome ([illegible])	Definition	Short-term reversible symptoms can be associated with occupancy of a specific building.	
	Symptoms	Effects can be eye and respiratory tract irritation, impaired respiratory function, respiratory infections, dizziness and headaches, fatigue, nausea, diarrhea, chest and abdominal pain, dermatitis.	Characterized by persistence of symptoms and consistent association with exposure to indoor air in specific buildings.

III. MITIGATION OPTIONS

There are two basic approaches to indoor air pollution mitigation: source controls and multipollutant strategies. Source controls remove or isolate pollutant sources to reduce indoor pollutant emissions. Multipollutant strategies are aimed at reducing indoor concentrations, typically through ventilation or air cleaning. Table 4 summarizes the various mitigation options, their pollutant applicability, and the individuals or agents who can initiate their use.

Source Control

Source control as a mitigation option includes source removal or substitution, design changes, and encapsulation and other physical barriers. These methods can be used by building designers or inhabitants or by the source's manufacturer. Source removal is an option that can be used by a building's occupants to effectively eliminate the pollutant source from the indoor space. This option has been employed as a control measure for asbestos in many buildings and is essentially 100 percent effective as a source control.

The substitution of one product for another is an option that building designers, builders, or occupants may use to reduce indoor emissions of pollutants. For example, the use of low-emission formaldehyde building materials in place of other higher emission rate materials during the design or construction phases would result in lower formaldehyde emissions in the building. Changes in product design or chemical content can be used by manufacturers to mitigate indoor pollution. These changes may have a significant effect on emission reduction as has been seen in pressed wood products where the development of newer products by manufacturers has significantly reduced formaldehyde emissions.

Encapsulation or the use of physical barriers can inhibit source emissions. This option can be used by the product manufacturer or by the builder or occupant of a building. This option is useful where the pollutant source is too large for removal or is inherent in the building structure. It has been shown to be an effective control measure for asbestos, formaldehyde, and radon. Encapsulation of asbestos can reduce the number of airborne fibers by 99 percent. Coatings have been shown to be effective in reducing formaldehyde emissions from pressed-wood products. Radon entry into a building may be reduced by sealing foundation cracks.

Table 4. Mitigation Options, Applicability, and Control Agents

Method	Description	Applicability	Control Agent
Source Control			
Removal or Substitution	Source is removed or replaced by a less contaminating source which fulfills same function.	All Sources	Designer, Builder
Change in Design	Design is altered for lower emissions.	All Sources	Manufacturer
Encapsulation	Impermeable material covers source to restrict emissions.	Continuous nonmechanical sources	Manufacturer Builder Inhabitant
Confinement	Source is used in a confined area	Localized sources	Inhabitants
Temporal Use	Source is used so only a few persons will be exposed.	Inhabitant-controlled sources	Inhabitants
Maintenance and Cleaning	Source is maintained and cleaned to prevent increased emissions.	Combustion and biological	Inhabitants
Multipollutant strategies			
Natural Ventilation	Open windows, doors, or vents.	All pollutants	Builders control placement; inhabitants control use
Mechanical Ventilation	Forced air movement replaces indoor air with outdoor air.	All pollutants	Builders select and install; inhabitants control use
Local Ventilation	Exhaust contaminants from specific source to outside.	Localized source	Builders or inhabitants place limits
Air cleaning by filtration or electrostatic interaction	Remove particles from air.	Particulates	Builders or inhabitants place limits; inhabitants control use
Air cleaning by adsorption	Remove [illegible] from air	Some gases and vapors	Builders or inhabitants place limits, inhabitants control use

Source control has several general limitation. It can be used only here the pollutant source is identified and where a feasible mitigation ethod exists. Source controls, particularly where building renovation r product redesign is required, include some of the most expensive otential mitigation methods. In addition, the methods discussed may pply only to a specific source and a specific pollutant.

ultipollutant Strategies

In addition to specific source controls are methods that reduce verall pollutant concentrations. These approaches include ventilation trategies and air treatment.

Removal of contaminants from indoor air using ventilation can be ccomplished by three ventilation strategies: 1) dilution ventilation, 2) local exhaust ventilation, and 3) improved ventilation efficiency. ilution ventilation reduces indoor air pollutant concentrations by eplacing indoor air with makeup air. In cases where the initial entilation rate is low, small increases in ventilation rate can enerally reduce indoor pollutant concentrations without a substantial ise in energy costs.

Local exhaust ventilation is used to minimize the transport of ollutants from a defined source to the general indoor air. The use of nis strategy to reduce concentrations in areas with strong pollutant ources (e.g., kitchens, bathrooms, smoking areas) can be much more ffective and less costly than providing increased ventilation to an ntire building.

Ventilation efficiency should be considered a possible means of mproving indoor air quality. In areas where uniform mixing of indoor ir is not achieved, contaminant stratification can occur, resulting in reas of higher exposure potential. Improving ventilation efficiency mproves the delivery of outside air to occupied spaces and minimizes ckets of dead air space.

Air treatment methods available for removing indoor air contaminants nclude filters, adsorbents, negative ion generators, and electrostatic recipitators. These methods are used separately or are combined in a ries within a single air cleaning device. Air cleaning can be fective in removing particulates; however, it has not been demonstrated be an effective method of controlling gaseous pollutants.

IV. RESEARCH

Prior to the enactment of the Radon Gas and Indoor Air Quality Research Act in 1986 (Title IV of the Superfund Amendments and Reauthorization Act (SARA)), EPA's indoor air research efforts were supported through supplements to research and development funding authorizations. EPA initiated a research program on indoor air quality in 1984. Funding for this program, through supplemental appropriations from Congress, has been $2 million per year for each of the three fiscal years since startup. In fiscal years 1984 and 1985, research on radon measurement and mitigation was included in the basic indoor air research program. In the current (1987) fiscal year, a separate $1.5 million was appropriated by Congress for radon mitigation, which has, in effect, become a separate program because of the uniqueness of radon as an indoor air pollution problem.

<u>Research in EPA</u>

EPA's research program has made significant advances in the state of knowledge on indoor air. For example:

- Through the Agency's air research program, progress has been made on several fronts. For example, through EPA's air toxics research effort, the Total Exposure Assessment Methodology (TEAM) was developed and validated. TEAM studies rely on state-of-the-art personal and ambient exposure monitors, plus a unique blend of scientific approaches, to determine human exposure to pollutants. The initial TEAM studies, which focused on volatile organic compounds (VOCs), provided critical evidence of the extremely high concentrations of VOCs indoors. The TEAM approach is currently being expanded to address exposure to particulate emissions. It is also being used in an EPA study of residential pesticide exposure.

- Through the innovative Integrated Air Cancer Program, EPA has been able to develop and field test instruments and methods to characterize carcinogens in ambient and indoor air, to identify the sources of these emissions, and to evaluate complex mixtures of pollutants to discover the most potent components of these mixtures and screen for possible health effects.

- Several significant advances have been made through specific health effects and source characterization studies. For instance, the exposure portion of a clinical study of children whose parents smoke cigarettes has recently been completed. A pilot field study has been initiated to examine the levels of nicotine in children of smoking parents, as well as to evaluate indoor levels of nicotine and other pollutants in the homes where the children live.

- EPA has a special testing chamber in which the Agency has pioneered research to determine the composition and rate of pollutant emissions for several common building materials and consumer products. Among the products tested so far are construction adhesives, flooring materials, paints, floor waxes, and moth crystals.

- Significant progress has also been made in the standardization of emission testing procedures and in the development of much needed personal and fixed monitoring equipment for assessing human exposures to indoor air pollutants. In addition, EPA is conducting studies to develop a model that can be used to estimate exposure from volatilization of chemicals from tap water into the home.

Because of the nature of the indoor air quality issue, two basic approaches will be taken in EPA's future research effort: a cross-cutting, generic approach that will focus on building design, ventilation, and the general characterization of indoor air exposures and a source-specific approach that will concentrate on controlling specific pollutants (e.g., radon) or specific sources (e.g., building materials). This dual approach will ensure that the research program is comprehensive.

Generic research needs will be addressed by projects that are aimed at developing standard measurement protocols for monitoring indoor air, establishing emission reduction baselines, and identifying and disseminating information regarding mitigation techniques to the public. Issues that will be assessed with this approach include:

- Characterization of air pollution in high risk buildings and various building types;

- Characterization of individual exposures to pollutants (the development and use of personal monitors, and the assessment of "total exposures" from the ambient and indoor environments);

- Identification of factors affecting exposure (building types/materials), ventilation levels and rates, and classes and types of consumer products; and

- Preparation of guidelines for mitigating/preventing indoor air quality problems (building practices, guidelines for defining acceptable indoor air quality, control technologies, and maintenance practices).

Source-specific research is necessary to ensure that important indoor air risks are not overlooked and to focus continued emphasis on known risks. This will allow assessment of known high risk categories, such as radon, as well as suspected high risk categories (e.g., biologicals contaminants from HVAC systems), and of combustion appliances and building materials and products. Seven exposure source categories have been established to focus research on specific pollutants/sources:

1. Environmental Tobacco Smoke.

Because this source of indoor pollutants is believed to contribute perhaps the largest overall risk to health, it is addressed in an individual category.

2. Combustion Appliances.

Combustion appliances for heating and cooking, particularly unvented ones, can be major sources of indoor pollutants. For example, these appliances are common sources of NO_2, CO, and particulate matter, all of which also occur (and are regulated) in the ambient environment. Of special interest is the risk from the total emissions containing numerous products of incomplete combustion, which are largely uninvestigated.

3. Materials and Furnishings.

Included in this category are building materials, which can be sources of asbestos and other fibers; furnishings, such as furniture and carpeting, which can be sources of formaldehyde and other organic vapors; and stored materials and various surface coatings, which can be sources of solvent-based organics.

4. Biological Contaminants.

Included are molds and their spores, bacteria, viruses, and insects and other products. Sources include moist areas or other favorable indoor environments, among them automobile and building air conditioning and ventilation systems and humidifiers.

5. Human Activities.

Many indoor exposures occur as a result of everyday activities, ranging from vacuuming (which can reentrain molds, dust mites, and other particles) to showering (which can produce vapors of chloroform and trichloroethylene present in water supplies). Of perhaps greatest concern are exposures during the use and application of commercial/consumer products, including pesticides, paints, solvents, cleaning agents, polishes, and waxes.

6. Ambient (Outdoor) Environment (Radon, Pesticides).

An indoor air pollutant of great public concern, radon originates primarily from the natural outdoor environment. Other significant indoor pollutants of concern that have their source primarily outdoors include pesticides, such as termiticides, that are applied to soils around residences.

7. Nonionizing Radiation.

Numerous sources of electric and magnetic fields are found indoors. Sources include any appliance that has an electric motor or electric heating element and electric light bulbs. Several major classes of effects have been observed from extremely low frequency electric and magnetic fields, but whether indoor exposures cause these effects is uncertain. The effects of negatively and positively charged ions in indoor air are also uncertain.

V. U.S. POLICY DEVELOPMENT

Current Status

The Superfund legislation in part directs the Administrator of the Environmental Protection Agency to establish an indoor air quality research program designed to contribute to the understanding of health problems associated with indoor air pollutants. The statute also directs EPA to coordinate with federal, state, local, and private sector research and development efforts related to improvement of indoor air quality and to assess federal actions to mitigate associated health risks. The statute also encourages EPA to disseminate information regarding indoor air pollutant sources and concentrations, high risk building types, measurement instruments, and health effects, as well as recommended methods for the prevention and abatement of indoor air pollution.

In June 1987, EPA prepared a Report to Congress, the EPA Indoor Air Quality Implementation Plan, in which the Agency's overall indoor air goals and policy objectives were identified. As presented in the Implementation Plan, EPA's ultimate goals in addressing indoor air quality problems are to characterize and understand the risks to human health that pollutants pose in indoor environments and to lessen those risks by reducing exposure to indoor pollutants. The Agency's indoor air program will seek to reduce the risks to human health posed by indoor air pollution through the pursuit of the following policy objectives:

- The Agency will conduct research to further refine its assessment of the nature and magnitude of the health and welfare problems posed by individual air pollutants as well as pollutant mixtures indoors. Such research will focus in the near term on improvement of exposure data, continued development and testing of modeling tools necessary to perform essential risk assessments, and the development and consolidation of data bases. Development of appropriate ranking and risk assessment tools will be a top priority in this effort.

- The Agency will identify and assess the full range of mitigation strategies available to address high priority indoor air pollution problems. Equal emphasis will be placed on strategies that reduce or eliminate the source of the risk, as well as on more generic strategies that may reduce exposures, and thus risks, to multiple pollutants simultaneously (e.g., ventilation-related strategies).

- For identified high risk, high priority problems, the Agency will adopt and carry out appropriate mitigation strategies. Strategies may involve one or more of the following:

  - issuing regulations under existing Federal regulatory authorities (e.g., Toxic Substances Control Act, Federal Insecticide, Fungicide, and Rodenticide Act; Safe Drinking Water Act);

  - building state and local government and private sector capability to address indoor air quality problems through nonregulatory programs of information dissemination, technical assistance, guidance, and training;

  - referring problems to other federal agencies with appropriate statutory authority (e.g., Consumer Product Safety Commission, Department of Housing and Urban Development); and

  - requesting separate indoor air regulatory authority from Congress if deemed appropriate.

In October 1988, EPA is required to report to Congress on its indoor air quality activities under Title IV and provide its recommendations.

Policy Approaches to Controlling Indoor Air Pollution

Although EPA's historical and traditional approach to environmental problem solving has been primarily regulatory in nature, the indoor air issue presents unique problems and issues for which regulatory solutions may not always be the most effective approach. Since indoor air pollution problems are largely a function of the products and materials used within specific building settings, the character of the problem will differ in each setting and the most appropriate mitigation strategy will depend on a variety of factors. In many instances, the Agency hopes to be able to achieve its indoor air policy goals through nonregulatory approaches, which will include research and development, information dissemination, and technical assistance and training. To a large extent, the Agency's success in reducing the risks to human health from indoor air pollution will depend upon how successfully the Agency is able to build public and private sector capability to investigate, assess, and solve indoor air quality problems, to effect change in product purchasing and use, and to change building design and operation to minimize the risks from indoor air pollution.

Administrative control options may be effective in reducing pollutant exposure to building occupants. Administrative alternatives are actions on the part of organizations in the public and private sector that influence or require mitigation of indoor air quality problems. Table 5 summarizes public and private sector roles in providing or servicing mitigation needs.

Administrative alternatives can be both regulatory and nonregulatory in nature. Regulatory alternatives include such actions as:

- Development of chemical-specific use regulations where high health risks are possible as authorized by the Toxic Substances Control Act (TSCA) and Federal Insecticide, Fungicide, Rodenticide Act (FIFRA), the Safe Drinking Water Act (SDWA), and the Resource Conservation and Recovery Act (RCRA).

- Development of chemical-specific standards for the office or school environments; and

- Development/modification of building codes and standards (e.g., air exchange rates).

The U.S. EPA has been conducting both regulatory and nonregulatory indoor air activities for the past several years. From a regulatory standpoint, the Agency has addressed a number of chemicals, including several pesticides, found indoors through the use of TSCA and FIFRA. These statutes enable EPA to obtain information on chemical substances from manufacturers and processors when there is reason to believe that the use of these substances may present an unreasonable risk to human health and the environment. Based on assessments of risks and benefits, the Agency determines whether or not an unreasonable risk exists for a specific compound; if so, the Agency can take action to control exposure to the substance, restrict its use, or ban the substance entirely.

To date, EPA has taken a number of actions under various statutes on specific chemicals that have been found to pose risks indoors. EPA has issued the Asbestos Worker Protection Rule to protect public employees not covered by the Occupational Safety and Health Administration (OSHA) from exposure to asbestos during abatement activities. The Agency has also proposed to phase out commercial uses of asbestos over a 10-year period. This proposed rule, known as the Asbestos Ban and Phase Down Rule, will significantly reduce future uses of asbestos and exposure to asbestos fibers in all environments, including indoors. The proposed Asbestos in Schools Rule was just issued under the Asbestos Hazard Emergency Response Act (AHERA) passed by Congress in October 1986. This

Table 5. Summary of Public and Private Sector Roles in Providing or Servicing Mitigation Needs

Responsible control agent	Role/responsibility
Individuals	• Purchase low emission products • Use, maintain, and store products according to specifications to minimize pollutant emissions • Exercise discretionary control over ventilation to ensure clean air supply • Be knowledgeable of indoor air quality problems and take actions to avoid personal exposure
Building owners and managers	• Adopt ventilation maintenance procedures to eliminate ventilation sources of pollutants and ensure an adequate supply of clean air to building occupants • Restrict high pollutant emissions to designated areas and use zone/spot ventilation or local exhaust for indoor sources • Develop specific procedures for the use of cleaners, paints, pesticides, and other products with high pollutant emission rates to protect building occupants • Purchase building supplies with low pollutant emission rates • Adopt investigatory protocols to respond to occupant complaints • Be knowledgeable of indoor air quality problems and take actions to avoid occupant exposure
Architects and builders	• Adopt indoor air quality as a design objective • Ensure compliance with indoor air quality ventilation standards • Specify low emission requirements in designs and procurement specifications for building materials from manufacturers • Provide for separation of occupants and pollutant sources in buildings • Specify containment or ventilation of known pollution sources • Be knowledgeable of state-of-the-art advances in interior design, HVAC and air cleaning systems, and other indoor air quality issues
Manufacturers of products	• Adopt test procedures and standards to minimize product and material emissions • Substitute materials to minimize pollutant emissions from products

Table 5. (continued)

Responsible control agent	Role/responsibility
Manufacturers of products (continued)	• Adequately label products as to emission level and proper maintenance and use of products • Conduct research to advance mitigation technology • Be knowledgeable of state-of-the-art advances in mitigative techniques and indoor air quality issues • Develop training programs for commercial product users to ensure low emissions
Professional engineering associations	• Adopt building codes for design, construction, and ventilation requirements to ensure adequate indoor air quality • Adopt test procedures to monitor pollutant emissions from products • Disseminate technical information to members concerning indoor air quality issues • Encourage research and development • Provide a forum for information exchange
Consumer and health professionals and organizations	• Be knowledgeable of symptoms, effects, and mitigation and advise clients • Develop information and education programs for members and for the general public
State and local governments	• Conduct studies of specific problems in state or local area and adopt mitigation strategies • Establish building codes for design, construction, and ventilation requirements to ensure adequate indoor air quality • Enforce and monitor code compliance • Educate and inform building community, health community, and public about problems and solutions
Federal government	• Coordinate actions of other sectors • Conduct research and technology transfer programs • Conduct specific programs to inform, encourage, or require specific sectors to take actions toward mitigation • Investigate high risk pollutant problems and take regulatory action as mandated by Congressional acts (e.g., TSCA, FIFRA)

rule requires schools to inspect for asbestos, prepare management plans, and take appropriate response action when friable asbestos is found.

In 1986, EPA prohibited the use of pentachlorophenol as a wood preservative for treatment of logs for log-home construction. Creosote and pentachlorophenol were also prohibited as preservatives indoors, with very few exceptions.

In 1983, EPA issued a phase-out of fumigation devices containing the pesticide lindane, used to control pests in residences. As of May 1986, such use of lindane is prohibited. The Agency is currently evaluating monitoring data received from manufacturers on chlordane and is examining the health effects and benefits data for chlordane and other termiticides, such as heptachlor and aldrin/dieldrin, to determine whether further regulatory action is necessary. A decision is expected on these compounds in 1987.

On April 16, 1987, the Agency announced the results of its risk assessment on formaldehyde, a probable human carcinogen. While decision-making options are under consideration, studies are being conducted of formaldehyde emissions from plywood and particle board used in mobile and conventional homes. The findings of these and other studies are being shared with OSHA and with the Department of Housing and Urban Development (HUD) for use in considering regulatory action.

Under the Safe Drinking Water Act (SDWA), EPA is currently considering the establishment of maximum contaminant levels for volatile organic compounds. Such compounds vaporize in hot water and are then inhaled.

EPA has recently instituted a nonregulatory program to mitigate risks from radon exposure in residences. This program involved demonstrations, technical assistance, training, and information dissemination. The EPA Radon Program, a potential model for other pollutant nonregulatory initiatives, is presented in Appendix A.

<u>Emerging Policy Issues</u>

Traditionally, EPA has approached air quality problems on a pollutant-by-pollutant basis. However, because of the nature of the indoor air issue, a multipollutant approach is also required to achieve the greatest reduction of risk. Emerging policy questions related to the U.S. approach include the following:

- What are the roles of the federal, state, and local governments, and private sector organizations in the design, operation, diagnosis, and remedial services for sick buildings?

- What is the most effective approach to providing information and technical services to the public?

- What is the proper role of the federal government in ensuring the establishment and operation of adequate ventilation systems for all buildings?

- What mechanisms would ensure that emissions from commercial/consumer products will not produce significant indoor contamination and risks?

- What should be the federal role in establishing indoor air quality standards or guidelines?

EPA is only one of many federal agencies that are either actively engaged in indoor air research or vitally interested in the research being conducted. Coordination of indoor air policy with the United States is achieved by EPA and other members of the Interagency Committee on Indoor Air Quality (CIAQ). A brief description of the areas of concern for each of the various CIAQ members is provided in Appendix B.

International Cooperation and Information Exchange

The United States also seeks to promote international scientific cooperation and understanding of scientific considerations in indoor air pollution on a range of technical matters. These activities add to scientific knowledge and contribute to protection of health. As part of its research effort, EPA participates in international information exchange programs relating to indoor air quality research. The predominant mechanisms for this information exchange are international conferences and workshops that are co-sponsored by EPA. Through these activities, EPA provides for the integration of research efforts being carried out by various countries.

EPA also takes part in cooperative research efforts with other countries. For example, as part of a cooperative effort with the Peoples Republic of China, EPA is conducting a study of lung cancer in Xuan Wei, a county in southeastern China. It is thought that the county's abnormally high rates of lung cancer are linked to indoor exposure to particle-bound organic compounds from the coal and wood cooking and heating fuels used by the residents of Xuan Wei.

APPENDIX A

Indoor Radon Case Study

APPENDIX A
Indoor Radon Case Study

The Environmental Protection Agency has identified indoor radon as a serious public health problem. Scientists estimate that between 5,000 and 20,000 people in the U.S. each year may die from exposure to indoor radon. When EPA released its strategy, it announced that as many as 8 million houses in the United States may be above EPA's recommended action level of 4 picocures per liter. Follow-up surveys in individual States indicate that even more homes may have elevated levels of indoor radon.

<u>Background</u>

Radon is a radioactive gas produced by the radioactive decay of radium-226, which occurs naturally in almost all soils and rocks. Radon is present in the atmosphere everywhere because of its release from radium decaying in the ground. Outdoor radon levels generally are low. Radon gas seeps into houses through cracks in the foundation, areas around drainage pipes, sump pumps and other openings in the foundation or walls. Typical indoor levels are usually about five times higher than average outdoor levels, but can be over ten thousand times higher. Exposure to such elevated levels may greatly increase an individual's risk of developing lung cancer.

<u>History</u>

Exposure to elevated indoor concentrations of radon gas was first recognized as a potential health problem in the State of Colorado in the 1960's when houses that had been built with materials contaminated by uranium mill tailings were found with high levels. In the 1970's, EPA discovered that some houses built on reclaimed phosphate lands in the State of Florida also had elevated radon levels. In December 1984, however, extremely high radon levels were detected in homes located on the Reading Prong, a geological formation which runs from New Jersey, through Pennsylvania and into New York.

While the Reading Prong area of Pennsylvania, New Jersey, and New York is the best known high-radon area in the United States at this time, indoor radon is potentially a widespread problem. Elevated radon levels have been found in houses in many States--not only where suspected geological factors or the presence of uranium deposits suggest that radon might be a problem. As public awareness increases, many States are responding by organizing radon programs to assess the extent of the radon problem and educate homeowners.

Recent Surveys

EPA established its Radon Action Program in 1985 in response to the serious radon problem discovered in the Reading Prong. The goal of our program is to significantly reduce the health risks of radon by forming a partnership with other Federal agencies and the States. Certain types of activities, such as research and technical studies, are best done by the Federal Government. Other activities, such as providing day-to-day advice to the public and detailed analyses of local situations, are best handled by State and local agencies because of their proximity to the problem.

EPA's Radon Action Program consists of four elements:

1. To assess the extent of the radon problem nationally (Problem Assessment);

2. To conduct research into methods of reducing radon levels in existing and new homes (Mitigation and Prevention);

3. To help States develop programs to measure and diagnose radon problems, as well as to assist the public (Capability Development); and

4. To develop information for the States to use in helping citizens understand the risks associated with radon and how to reduce them (Public Information).

Problem Assessment

EPA has two complementary activities underway to assess the extent of the radon problem. A national survey is being designed to better define the distribution of radon levels in houses across the country. The Agency is also assisting States in designing and conducting their own surveys to identify high risk areas within the State and to determine the distribution of indoor radon levels across the State.

Ten States were surveyed in fiscal year 1987. Over 10,000 houses were measured in more than 600 counties. Elevated levels were found in every survey State and the distribution of radon levels varied among States; radon "hot spots" were found within States that had relatively low State-wide distributions. These surveys confirm that geology is a good indicator of high risk areas. For fiscal year 1988, seven more States and three Indian tribes have been selected to participate in EPA's Radon Survey Assistance Program. Standardized measurement methods have been issued to ensure the comparability of radon measurements

EPA and the United States Geological Survey are conducting Land Evaluation Studies to more precisely identify those geological factors and characteristics which are most useful as indicators of high radon levels. EPA is also conducting preliminary work on the use of soil gas measurements to predict the radon potential for individual parcels of land.

Mitigation and Prevention

EPA has been working closely with the States in conducting a research and demonstration program for reducing indoor radon levels. These houses had initial average radon levels ranging from 6 to 1,200 picocuries per liter (pCi/l). Indoor radon levels have been reduced in most of the homes by more than 90 percent.

In addition to our demonstration work of reducing radon levels in air, we have recently released a brochure on methods to remove radon from drinking water.

EPA has initiated a House Evaluation Program (HEP) to evaluate the cost and effectiveness of mitigation methods in the private sector and to train State and private sector personnel in diagnosing and mitigating radon in houses. We have completed 80 homes in the HEP and identified radon entry pathways and mitigation alternatives and have provided diagnostic training to over 50 State and local personnel.

The results of EPA's mitigation efforts have been very promising. Private contractors are successfully reducing radon levels at a reasonable cost and the number of contractors performing mitigation services is increasing.

A critical element in reducing the health risk from radon exposure is to prevent radon entry in new construction. EPA is planning to demonstrate radon resistant techniques in up to 125 houses this year. EPA and the National Association of Home Builders recently released a brochure that demonstrates radon resistant techniques in new construction.

Capability Development

Another important aspect of the Radon Action Program is to develop State and private sector capabilities to diagnose and reduce indoor radon levels. A technical training course for Federal and State officials and private contractors was developed and has been offered approximately 28 times to over 1,500 State officials and private contractors. The course is also made available on videotape.

The Agency provides technical advice on radon measurement methods and calibration services to the States and private firms. To ensure that those in the radon measurement business meet certain minimum standards, EPA established the Radon Measurement Proficiency (RMP) program. Participation in this quality assurance program is voluntary, but some States are using the proficiency evaluations as a basis for certification. The program has grown from 35 firms and 47 detection methods in the first round to 360 participants and 590 methods tested in the most recent round. Presently there are over 800 applications for the sixth round scheduled for February 1988.

Public Information

As public concern about the health risks associated with indoor radon increased, the development and dissemination of public information became a high priority for the States and EPA. In 1986, EPA released two brochures, "A Citizen's Guide To Radon: What It Is and What to Do About It," and "Radon Reduction Methods: A Homeowner's Guide." More than 250,000 copies of these publications have been distributed by EPA and the States.

EPA staff participate in frequent seminars, symposiums, and public meetings to discuss health risks from indoor radon and to disseminate information and have participated in television and radio appearances discussing radon.

Conclusion:

Federal Coordination

There is active interest on the part of other Federal Agencies to evaluate the problem of elevated radon concentrations in homes. EPA and the Department of Energy have cooperated in a research project on radon mitigation diagnostics. The Department of Housing and Urban Development is assisting us in developing inexpensive and effective mitigation techniques. These different agency concerns have led to the formation of several forums and intra-agency committees to discuss the indoor radon problem.

In September 1986, Congress passed the Superfund Amendments and Reauthorization Act of 1986 (SARA). Within this Act, Title I- the Radon Gas and Indoor Air Quality Act (1986), directs EPA to conduct a national assessment of radon, to demonstrate radon mitigation methods, and to carry out other research and public information activities.

To complement existing efforts, several pieces of proposed legislation have been introduced in Congress. The most comprehensive legislation, the State Radon Program Development Act, would direct EPA to expand technical assistance to States on radon issues and would provide $10 million annually in FY 1988, 1989, and 1990 for grants to help States develop their radon programs. The bill would provide $1.5 million to expand EPA's radon training activities and proficiency testing programs. The bill would also provide $1 million for EPA to conduct a study of radon contamination in the nation's schools, plus an additional $500,000 for demonstrations of radon reduction techniques in schools. A recent amendment to the bill would direct EPA to conduct a radon survey in Federal buildings.

Other radon bills under consideration would provide IRS tax breaks for the costs of correcting radon problems in residences and eligible medical expenses; establish a Housing and Urban Development program to assist States and localities in modifying building codes to require testing for radon; and require EPA to establish a standard for exposure to radon in indoor environments.

Under the Safe Drinking Water Act - EPA is developing drinking water standards for radon and other radionuclides; these will be published in June of 1989.

The success of the efforts to date rests on the partnership that has developed with the States during the past two years. For the past two years, EPA's efforts have been successfully directed toward meeting the urgent needs of the States affected by the Reading Prong. In the future, the Agency will focus on fulfilling its regulative responsibilities and assisting those States which are now finding elevated levels.

EPA is expanding its mitigation efforts into States outside the Reading Prong and will include a variety of housing types in various climates. Working with building code organizations will help to ensure that radon-resistant techniques are incorporated into new construction practices through modifications to local building codes.

EPA will continue to provide technical assistance to States to enable them to develop radon programs and expand private sector capabilities. Several of the programs the Agency developed in response to the needs of the Reading Prong will be continued and expanded to assist other States.

With the anticipated growth in the radon measurement industry, EPA's quality assurance progra- will continue to provide a critical service to the States and the puc

The Agency will also work to provide States with some of the information necessary to help howeowners understand and evaluate the radon problem. An effective public education program is an essential component of EPA's approach to reducing risks from indoor radon.

The Agency is pleased with the results of its initial efforts. States are accepting their responsibilities and are helping citizens reduce their risk from indoor radon. By strengthening this Federal-State partnership, EPA can achieve the mutual goals of reducing the public health risks from radon.

APPENDIX B

Members of the Interagency Committee on Indoor Air Quality (CIAQ)

U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460

A number of offices within the Environmental Protection Agency have responsibilities related to indoor air quality. The Office of Program Development (OPD) within the Office of Air and Radiation has primary responsibility for establishing indoor air policy and coordinating the activities of various EPA offices. In addition, OPD serves as the focal point for Agency policy coordination with other federal agencies, state and local governments, and the private sector. The Office of Research and Development has primary responsibility for the technical aspects of the indoor air quality research program called for under Title IV of SARA, as well as other research related to indoor air quality. The Office of Radiation Programs within the Office of Air and Radiation has primary responsibility for implementing the Agency's Radon Action Program and carrying out the radon research program mandated by SARA Title IV. The Office of Pesticides and Toxic Substances is responsible for regulating pesticides and toxic substances, some of which are used indoors and contribute to indoor air pollution. The Office of Policy, Planning and Evaluation has general responsibility for reviewing policy developed by the program offices. The Office of Air Quality Planning and Standards, although not directly involved in indoor air quality activities, has developed some expertise on indoor air and human activity patterns in implementing the ambient air programs. The Office of Water sets standards for pollutants in drinking water, some of which are of concern for their ability to volatilize and contribute to the indoor air pollution problem. The EPA regional offices serve as the contact between EPA and state and local governments.

U.S. Consumer Product Safety Commission
Room 700
5401 Westbard Avenue
Bethesda, MD 20207

The Consumer Product Safety Commission (CPSC) has regulatory authority over most sources of indoor air pollution. In that capacity, CPSC focuses on the determination and reduction of health risks posed by the use of structural materials, combustion sources, consumer products, and chemicals used in the home and schools. The Consumer Product Safety Act (CPSA) and the Hazardous Substances Act (HSA) provide the basis for establishing standards and instituting recalls or bans in order to address identified hazards.

U.S. Department of Energy
100 Independence Avenue
Washington, DC 20585

The Department of Energy (DOE) conducts a variety of activities related to indoor air quality in support of DOE policies to encourage the use of advanced energy conservation measures while maintaining a safe and healthful indoor environment. These activities include identifying indoor air pollutant sources and factors affecting human exposure, determining the relationship between indoor air quality and energy conservation, and developing control and mitigation techniques. Bonnerville Power Administration (BPA), part of DOE and also a member of CIAQ, conducts similar research in the Northwest.

Department of Health and Human Resources
National Institute for Occupational Safety and Health
944 Chestnut Ridge Rd.
Morgantown, WV 26505-2888

The Department of Health and Human Services (DHHS) investigates buildings for indoor air quality problems (through NIOSH), provides funding for a major health study of people exposed to indoor and outdoor pollutants in various areas of the country ("Six Cities Study"), conducts health effects studies, and develops health databases (through NIEHS).

U.S. Department of Housing and Urban Development
Room 8100
451 7th Street, S.W.
Washington, DC 20410-6000

The Department of Housing and Urban Development (HUD) is responsible for establishing and enforcing standards for properties being financed with HUD/Federal Housing Administration-insured mortgages or assisted through one of the HUD-assisted or directed loan programs; HUD also establishes, manages, and enforces the Federal Manufactured Housing Construction and Safety Standards. Past research efforts have included developing and instituting standards for formaldehyde emissions in materials in manufactured housing; investigating the problems of radon infiltration in housing built on mine tailings in Grand Junction, Colorado and Butte and Helena, Montana; and arranging for tests of radon mitigation approaches on Florida phosphate lands.

U.S. Tennessee Valley Authority
3N 51A Signal Place
Chattanooga, TN 37402-2801

The Tennessee Valley Authority's (TVA) indoor air program is primarily concerned with investigating the interrelationships among building construction characteristics, energy use, conservation, and indoor air quality, and with developing public information dissemination approaches. In addition to establishing these general relationships, exposures of specific population groups to unique indoor environments, such as those found in public housing, commercial buildings, and rural housing are being studied. Indoor air quality in commercial buildings operated by TVA, as well as the environment in the industrial workplace, is being investigated.

U.S. General Services Administration
Room 4320
18th & F Streets, N.W.
Washington, DC 20405

The General Services Administration (GSA) develops indoor air quality policies for federally-owned buildings.

National Aeronautics and Space Administration
National Space Technology Laboratories
Building T2423
NSTL Station, MS 39529

The National Aeronautics and Space Administration (NASA) conducts studies and maintains an extensive database on pollutants found in indoor environments.

U.S. National Bureau of Standards
Room A1138, Administration Building
Gaithersburg, MD 20899

The National Bureau of Standards (NBS) develops measurement standards and through its Center for Building Technology (CBT) conducts laboratory, field, and analytical research and develops models to predict, measure, and test the performance of building materials, components, systems, and practices.

(13) HB 519

General Principles for the Resolution of Indoor Air Complaints

Edward N. Light

Abstract

Public Health agencies are increasingly being asked to resolve complaints related to various indoor air exposures. A screening process is suggested to help determine what, if any, air testing is justified in each situation. When the goal of an investigation is to provide general problem identification, extensive and highly accurate sampling may not be necessary. Testing can often be limited to indicator pollutants. Test conditions should include worst case exposure, when feasible. A thorough inspection should precede final determination of sampling strategy. Interpretation of test results must take into account variations in source and environmental factors. Distinctions should be made between ventilation-related and source-related situations and also between primary and secondary sources. Methods of evaluating exposure include comparison with guidelines, generalized statements of risk and specific medical diagnoses. Effective remedial measures can be recommended for most indoor air exposure problems.

The increasing public recognition of indoor air pollution translates into a major new challenge for public health agencies. Most health departments now receive requests to resolve questions and disputes regarding alleged indoor air exposure to a variety of potentially toxic agents. While the techniques needed to assess such situations are often new, the principles guiding such investigations are similar to those customarily used in traditional environmental health program areas. For example, the strategy for tracing the origin of an outbreak of foodborne illness or the response to a complaint over unsanitary conditions in an institution may follow the same type of sampling and inspection procedures needed for indoor air.

Some of the more common indoor air complaints being received by health departments are listed in Table 1. Since the potential volume of such complaints can be high, it is often necessary to assign priorities. A health-based scheme for prioritizing indoor air investigations is presented in Table 2.

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Table 1
Common Indoor Air Complaints

- Asbestos
- Building-related illness
- Poor ventilation
- Odors
- Insecticides
- Carbon monoxide
- Tobacco smoke
- Formaldehyde

Table 2
Prioritization of Indoor Air Complaints

1. High potential for chronic disease
2. Acute illness occurring
3. Minor temporary symptoms only
4. Hypersensitive responses only
5. Nuisance odor or dust
6. Curiosity

Table 3
Multi-Party Indoor Air Disputes

- Product liability (i.e., mobile homes)
- Service liability (i.e., termite control)
- Landlord/tenant (i.e., ventilation)
- Labor/management (i.e., office workers)
- Owner/occupant (i.e., school)
- Smoker vs. non-smoker

Indoor air complaints may be pollutant-related, symptom-related, or both. Pollutant-related refers to an observation or concern that specific contaminants or indicators are present. Symptom-related reflects a concern that pollutants (sometimes unknown) may be contributing to occupant illness.

While some indoor air complaints may only involve a request to resolve an exposure question for a home or building owner, many encompass disputes between two or more parties. Table 3 provides examples of such situations. Few indoor air problems are covered by exposure or product standards, making resolution dependent on either voluntary compliance, private litigation or, in the case of extreme health hazards, special enforcement action. Constrained by a lack of technical guidance and resources, health departments have been reluctant to initiate comprehensive indoor air testing programs.

Complaint Screening

Indoor air complaints range from the frivolous to the immediate emergency, with the accuracy of initial information reported by occupants often suspect.

Under such circumstances, a screening process is desirable before committing resources to a field investigation. Some health departments require a physician's statement prior to testing. However, most physicians' knowledge of indoor air pollution exposure is limited. An alternate approach utilizes locally available experts to inspect potential sources of indoor air pollution in a complaint residence or building. Table 4 lists contractors or service organizations which can be of assistance in conducting such evaluations. Their observations can then be discussed with the health department to determine the appropriate response.

Table 4
Screening of Indoor Air Complaints

- Physician
- Heating/cooling contractor
- Plumber/sewer authority
- Ventilation consultant
- Gas company/fire department
- Pest control operator
- Equipment service representative
- Commercial laboratory
- Mail order test kit

Following the initial screening, if the problem appears to be either routine and predictable or low priority, the health department may choose to provide only general advice (suggestions, literature, referral) with no on-site visit. Where an inspection is warranted, detailed information from the complainant in the form of a phone interview or detailed written request is helpful in the development of an effective and efficient investigation strategy. A complainants' description of symptoms and potential sources will often reveal patterns which suggest or rule out different types of problems.

General Strategy

Factors affecting indoor air complaints can be complex, with the most obvious source not always related to the problem. In some complaints, a totally unrelated factor may be responsible for the observed symptoms. This may include illnesses with a medical, food or water-related, or pychosomatic origin. An investigation protocol should consider the possibility of such alternative explanations where indicated.

When an indoor air complaint is accepted for investigation, a realistic goal must be set, based on the priority of the situation and available resources, to determine the scope of the study. Such studies can range from an initial screening (where relatively few samples and observations of limited accuracy are used to identify general problems) to a more detailed evaluation of specific sources, exposure, and remedial measures. The majority of health department indoor air investigations tend to fall into the screening category. More detailed studies tend to be reserved for cases where legal action may be involved. In some cases, an initial health department screening can be followed with more detailed testing by a commercial laboratory or consultant.

Since indoor air quality issues often become controversial and are easily sensationalized, it is important to deal fairly and openly with all parties in a dispute. A general explanation of sampling strategy and evaluation criteria before testing will tend to make the eventual recommendations resulting from a study more acceptable. It is essential to put exposure information in proper perspective. This may necessitate withholding initial data until it can be interpreted in a more complete context.

Interview/Inspection

Before any testing is initiated, occupant histories should be collected through interviews or a questionnaire and the facility inspected. The histories help to determine if there is a pattern of building-related symptoms which suggest or rule out particular sources. They also may suggest whether the reactions are widespread or possibly due to hypersensitivity. Similarly, occupant observations of unusual odors, dust accumulation, equipment malfunctions, etc., may help to identify suspect sources. The collection of occupant histories is generally followed by a walkthrough of the facility accompanied by a person knowledgeable in the building and its activities. At this time, building materials, chemical use, equipment, activities, ventilation and other factors related to indoor air quality (odors, soot, dust, mold growth, etc.) should be noted. Table 5 presents an example checklist which can be used to help select which potential sources appear to be serious enough to require further consideration.

Testing

After sources and/or pollutants are selected for testing, a sampling strategy must be developed. Far too many indoor air tests have been conducted in nonrepresentative conditions, using inappropriate sampling procedures, resulting in misleading conclusions. One common mistake is the assumption that all industrial hygiene methods are directly applicable to indoor air pollution. Indoor air situations involve unique test conditions and require a lower detection limit than the industrial environment.

Ideally, indoor air sampling should be conducted under conditions which reflect both average and peak occupant exposure. To accomplish this, the effects of changes in ventilation, temperature, occupant activity, and equipment operation must be estimated. Such variations must be considered when selecting sampling conditions and locations. In this regard, it is sometimes suggested that environmental conditions be manipulated before sampling indoor air. For example, a formaldehyde test might be preceded by closing all windows and raising the temperature to 80°F in order to approximate peak occupant exposure. On the other hand, a home which has been unoccupied may have accumulated excessive formaldehyde and should be ventilated prior to conducting a representative test.

Health department testing of indoor air should normally be limited to situations where the data generated will help resolve a potential health problem. When an obvious problem is involved (i.e., sewer gas), reasonable recommendations may be made without resorting to characterization of pollutants and measurements of exact levels.

In addition, testing should generally be limited to pollutants which the initial inspection and occupant histories suggest are potential problems. Often it is possible to test for an indicator pollutant and use the results to assume exposure to associated contaminants (i.e., carbon dioxide). In some instances, the ideal list of tests for a given site must be reduced due to resource limitations, or expanded for public relations purposes.

A goal for sample accuracy should be selected based on the testing objective, although it will often be limited by the availability of equipment and expertise. Where only screening is being conducted, general range finding with an error of ±50% or more may provide sufficient data to determine if exposure is high, moderate, or low. In some cases qualitative sampling alone may be sufficient. On the other hand, testing for legal or medical purposes may require accuracy to ±5%. Similarly, quality control and chain-of-custody requirements will vary greatly depending on the goal set for an investigation.

The number of samples is usually constrained by time and cost, but should be adequate to characterize, at a minimum, average and/or peak exposure. Such samples must be collected from the breathing zone of an occupied area. In addition, it is often helpful to collect samples which distinguish major from minor sources and help characterize their dynamics. This may be accomplished by diagnostic air sampling in or next to a specific source (i.e., cabinet made from particleboard). Sometimes bulk or wipe sampling of potential sources helps to define their emissions.

Where the complaint is due to a pollution source which is intermittent or has since ceased, it may be possible to collect samples which provide historical evidence of exposure. For example, settled dust can be sampled for asbestos content, or fabric for the adsorption of persistent pesticides. In the case of an intermittent odor not present during the onsite visit, it may be advantageous to leave test equipment with a reliable individual in the building along with instructions to collect a sample during a major odor incident.

Table 5
Building Inspection Checklist

Potential Problem	No Apparent Problem	
______	______	1. Lack of fresh air?
______	______	2. Inadequate air circulation?
______	______	3. Excessive cigarette smoke?
______	______	4. Air too dry during heating season?
______	______	5. Poorly vented heating equipment?
		(specify) ______
______	______	6. Pollution source near air intakes?
		(specify) ______
______	______	7. Mold growth in building?
______	______	8. Odor from new finishings or materials?
		(specify) ______
______	______	9. Odor from chemical use? (paints, cleaners, pesticides, etc.)
		(specify) ______
______	______	10. Sewer odors?
______	______	11. Other unusual odors?
		(describe) ______
______	______	12. Deteriorated suspect asbestos materials?
______	______	13. Other unusual dust accumulation?
		(describe) ______
______	______	14. Excessive emissions from equipment? (printing, etc.)
		(specify) ______
______	______	15. Excessive exposure in special activity areas? (labs, shops, art rooms, etc.)
		(specify) ______
______	______	16. Infiltration from attached garage?
______	______	17. Other (describe) ______
		______

Sample duration should ideally be determined by the type of potential health problems involved. For example, short-term peak samples may best reflect the action of an eye irritant while long-term average levels may be critical for carcinogens. However, time constraints and equipment limitations often restrict complaint sampling to an instantaneous or short-term measurement. Where the amount and duration of sampling must be limited, consideration for representative conditions during the testing is especially important.

Interpretation of Results

Air sampling data should only be considered as an exposure estimate after fluctuating environmental and source factors have been taken into account. One method used to accomplish this is the adjustment of readings to levels which would be expected to occur at a standard condition (i.e., convert formaldehyde levels to 77°F). Another approach is to state that a reading only represents exposure at the moment of sampling and will vary under different conditions (for example, higher exposure is often likely when there is less ventilation or greater source activity).

When exposure estimates, occupant histories, and inspection results combine to create a fairly consistent picture of indoor air quality at a given location, an attempt can be made to draw specific conclusions. For instance where readings are low and there are no other indications of a source problem, negative findings can be stated. If the study has been limited in scope, it is important to emphasize potential limitations in any conclusions due to methodology.

In identifying the origin of an indoor air problem, source-related situations can usually be distinguished from those that are ventilation-related. In the former category, source emissions are excessive and must be directly controlled. In the latter, ventilation is inadequate and allows the accumulation of normal building contaminants.

Another distinction should be made between primary and secondary sources. Primary sources produce the original pollutant emissions. Secondary sources collect these contaminants for release at a later time (i.e., dust from an HVAC system or odor from a fabric).

Three basic approaches are available for evaluating exposure to indoor air pollutants. The first involves comparison with standards or, more commonly, guidelines to define relatively safe exposure levels for the general population. Such guidelines may be in the form of either allowable pollutant concentrations, product standards, work practices, or ventilation rates. Standards for exposure to pollutants at industrial or construction sites are generally not directly applicable to indoor air investigations but are sometimes reduced by a factor of 10 or more to account for continuous exposure to sensitive individuals.

The second method of evaluating exposure is a generalized risk assessment. This divides pollutant exposure into different ranges (background, low, moderate, and high) taking into account the incidence of various health problems. For example, a low level might be defined as one where only allergic individuals experience symptoms, or a high level designated when the expected cancer risk exceeds 1/10,000.

The final method involves a specific medical diagnosis. In this case, information on pollutant exposure is presented to a patient's physician, where it is evaluated in conjunction with a physical examination and medical history to determine if symptoms are exposure-related.

Whenever symptoms related to indoor air pollution are suspected, investigations should consider the possible explanations of hypersensitivity and mass hysteria. In the former case, a very small percentage of sensitized individuals exhibit symptoms at levels far below those affecting the normal population. A solution must often involve either complete elimination of the pollutants in question or relocating the individual. Mass hysteria and other psychological phenomena may explain some symptoms incorrectly attributed to indoor air pollution. These must be diagnosed with great caution and only after all other reasonable possibilities have been eliminated.

Where an indoor air pollution problem and its sources are positively identified, specific recommendations can be developed. However, some investigations result in the finding of more than one suspect source and no clear-cut abatement strategy. In this instance, a trial and error approach may be suggested, eliminating potential sources one at a time until symptoms or contaminant levels are controlled. Alternatively, general problem identification by the health department can be followed with more detailed testing by a specialist to develop an effective control program.

Recommendations for the control of indoor air pollution can often be implemented in a two phase approach: immediately available temporary measures and permanent measures (Table 6). Follow-up testing may be offered by the health department to evaluate the effectiveness of control measures. This can again be made dependent on the priority assigned to the situation and resources available.

Table 6
Control of Indoor Air Pollution

Temporary
- Isolate
- Evacuate
- Reschedule
- Ventilate
- Clean
- Cease operation

Permanent
- Seal
- Replace
- Increase ventilation
- Adjust equipment
- Filter

Discussion

The investigation of indoor air pollution complaints has emerged as an important new environmental health program area. Since resources for conducting such activities are restricted in most health departments, it is often necessary to limit investigations to only priority situations and utilize sampling strategies which are sufficient to identify only general problem areas.

While experienced sanitarians can be most effective in conducting indoor air screening investigations, the detailed investigations necessary for the development of complex abatement programs may not be feasible for many health departments. When necessary to resolve non-routine requests of this nature, supplemental assistance may be solicited from other organizations, both public and private. Such detailed studies may require multi-disciplinary, team effort.

Utilizing the systematic approach presented in this paper, many indoor air complaints can be successfully resolved without resorting to legal action. Even though few formal standards currently apply to the regulation of indoor air pollution, site-specific health department findings and recommendations tend to carry considerable weight in the settlement of multiple-party disputes involving such issues. Where a health department can document potentially harmful exposure and present the responsible party with practical suggestions regarding abatement, voluntary improvements in indoor air quality generally result.

Rabies Report Shows 1984 Cases Down

The Centers for Disease Control's Rabies Surveillance Annual Summary 1984, issued December 1985, shows rabies in wild animals in the United States totaled 5,174 cases, in domestic and farm animals 453 cases, and three human cases. The total of 5,630 cases in 1984 in the U.S. was down 4% from the previous year's 5,881 cases.

In Canada, of 1,699 reported cases, 1,365 were wild animals; 333 were domestic and farm animals, and one was human.

In Mexico, of 10,346 reported cases, 9,857 were domestic and farm animals; 431 were wild animals and 58 humans. The total represented an increase of 3,487 cases over 1983.

In the U.S., there was an increase of raccoon rabies cases in Pennsylvania and Maryland and a decline in Virginia, West Virginia and the District of Columbia, showing a northern movement of the epizootic. A study of rabies in skunks is being conducted in the states of Texas and New York.

Of the rabies in domestic and farm animals in the United States, cattle continued to be the predominant animal infected, followed by cats, which outnumbered dogs for the fourth consecutive year.

Canada reported a 40% reduction in cases of rabid domestic and farm animals; Mexico showed a marked increase in the number of reported rabid dogs, from 3,176 in 1983 to 9,274 in 1984.

Some Soils Filter Acid Precipitation

University of Wisconsin Soil Scientist, James Brockheim, reports on an Electric Power Research Institute funded study, saying that soils in northwestern Wisconsin are capable of neutralizing acidic precipitation before it reaches groundwater or seeps into lakes. Brockheim's research shows that rain is neutralized when it hits the leaves of trees and in percolating through the soil in the study area, it becomes nearly 100 times less acid than when it fell.

(14) HB519

Local part of radon study complete

by PHIL CARSON

A radon detection study of 21 Routt County homes has just been completed and results should be back to homeowners in two months, a local health official says.

According to Environmental Health Director Mike Zopf, the 21 homes were selected from a list of 65 county homes randomly selected by a computer.

Cannisters were placed in the study homes for 48 hours to register radon levels.

Those individuals whose homes were used in the study will get a response from the federal Environmental Protection Agency on the radon level in their homes. Zopf also hopes to receive some data on home-types and geologic conditions which might be conducive to unhealthy radon levels.

Radon gas occurs naturally due to the decomposition of uranium, which is found in different concentrations in various soil and rock types. If trapped inside a home, for instance, high concentrations of radon gas can cause lung cancer in certain people.

How big is the threat? Scientists estimate that 5-20,000 lung cancer deaths annually are attributable to radon gas. In comparison, the American Cancer Society projects 130,000 people died in 1986 from smoking.

An individual's risk of developing lung cancer from radon depends on the concentration level of the gas and the length of time that person is exposed to it.

Still, Zopf says, radon can be a health hazard and steps can be taken to reduce the risk.

The first step is testing your home. Reliable test kits are available to homeowners and approved laboratories can analyze the results. Zopf has available to homeowners a list of test kit manufacturers and labs. His office at the courthouse annex also carries two pamphlets: "A Citizen's Guide to Radon - What It Is and What To Do About It," and "Radon Reduction Methods - A Homeowner's Guide."

"I'd be glad to talk to anyone who would like to test their home," Zopf says.

ADV IN ANCHORAGE PAPER

(15) HB 519

Testimony of Phil Loudon, Nortech April 1988

Radon gas is being found in an ever widening arc that now incorporates the Chena flood plane, as well, as the Fairbanks hill sides. The only recognized health effect of exposure to high levels of radon gas is lung cancer, and like lung cancer, encountering radon is a very private matter for the majority of our clients. People do not enjoy talking about lung cancer, or radon gas, and seldom do they share their experience with others.

If we compare the health effects of radon gas to those of asbestos, we find a great disparity in the respective threat levels. While asbestosis is responsible for between 750 to 1,000 deaths each year, radon exposure is estimated to kill from 10,000 to 30,000 U.S. citizens annually.

Radon gas is a natural disaster, however, unlike a flood or earthquake, radon kills with a slow painful death. Fairbanks demands your attention and your compassion. It has been over one year since the Fairbanks radon problem was made public in Juneau. I urge you to make yourselves aware of the magnitude of our radon problem and the specific needs necessary to deal in a rational manner with this problem.

Specifically we ask for the following assistance:

1. A local, state supported calibration facility. The department of Geological and Geophysical Survey can serve in this capacity with minimum funding as they already have trained personel and a good portion of the necessary equipment. We recently experienced confusion over the accuracy of two different methods of radon testing. This confusion resulted in delays and misunderstanding that should never have happened, and would not, had a local radon gas standard been available by which these methods could be calibrated against.

2. We need a better understanding of local geological factors if, we are to know which soils and what areas are most at risk. Without this information new houses will possibly be built in high risk areas without the additional measures necessary to guarantee that radon accumulation will not be a problem.

3. Solutions for radon mitigation of cold climate buildings is in its infancy. Residential construction in the Fairbanks area in general, is out of necessity, years ahead of other "radon rich' communities regarding issues of quality construction, envelope air tightness, and thermal efficiency. Due to our unique climate and the above issues, solutions for high radon concentrations in Fairbanks homes is underdeveloped at best, and disastrous at the worst.

Please support HB 519 and 520, or their concepts in another bill as the need is known and the tip of the radon iceberg has been located in Fairbanks. Thank you for this opportunity to inform you of my experience on this very critical subject.

put w/ today's
packet

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FOR: Rep. Davis, Rep. Frank, Rep. Pourchot, Rep. Springer, Senators Coghill, Fahrenkamp + Fanning PHONE:

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PUBLIC OPINION MESSAGE

(16) HB 519

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APR 22 1988

NAME: PHIL LOUDON
TITLE:
ADDRESS: 109 WATERLOO LANE
CITY: FAIRBANKS ZIP: 99712
PHONE: 451-8378
BILL NO:
SUBJECT: FAIRBANKS RADON GAS PROBLEM
MESSAGE: PLEASE GIVE CAREFUL CONSIDERATION TO FUNDING DGGS RADON GAS STUDY. I HAVE EXPERIENCED THE CONFUSION WITH SEVERAL OF MY NEIGHBORS OVER OUR EXTREME HIGH LEVEL OF RADON GAS. IF POSSIBILITIES OF LOW INTEREST LOANS EXIST, PLEASE GIVE YOUR SUPPORT TO THEM ALSO. THANK YOU. EOM-FZ-C

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