Exhibit 15

CHAPTER 12
AIR QUALITY, NOISE CONTROL and INDOOR AIR

BOARD OF HEALTH ROLE AT A GLANCE

$ Respond to complaints about, and determine sources of, air pollution that is damaging, irritating or injurious.

$ Order the abatement of offending emissions from sources within the municipality.

$ Refer complaints to DEP when air pollution is originating from a neighboring community.

$ Issue local air pollution, noise, odor or noisome trade regulations as needed.

$ Local boards of health have jurisdiction over public schools, buildings that the general public enter and municipal buildings. The board of health (BOH) should be prepared to respond to requests for information concerning indoor air quality of these buildings from the community. When complaints concerning indoor air quality are received, including complaints of radon and asbestos, the BOH will need to refer this information to the Bureau of Environmental Health Assessment (BEHA) at the Department of Public Health (DPH). BEHA will respond to complaint referrals from the BOH by conducting an investigation of the problem.

As provided in 310 CMR 7.52 of MassDEP's Regulations for the Control of Air Pollution, Board of Health officials are authorized to enforce the following regulations:

- 310 CMR 7.07 Open Burning
- 310 CMR 7.08(1) (c) and (d) Regarding domestic incinerators
- 310 CMR 7.09(1) through (4) and (6) Dust, Odor, Construction and Demolition
- 310 CMR 7.10(1) Noise
- 310 CMR 7.11(1) (b) Transportation Media - Excessive idling and 7.11(2) Diesel Trains

OVERVIEW

Bad-smelling vapors (miasmas) rising from decaying matter were at one time believed to be the cause of yellow fever epidemics. The ancient Romans first used the word "malaria" to describe air they believed had been tainted in this way.

In this country, combating "bad air" to control disease was a major motivation for the early establishment of boards of health. Massachusetts health boards have long been empowered by the state Legislature to make regulations, enter buildings and board ships to prevent, abate or eliminate conditions that could lead to air pollution.
The miasmas of yesteryear were usually local phenomena from natural sources. Today, our bad air is

caused chiefly by man: chemical emissions react in the atmosphere and extend to whole regions and across international borders. Our air is contaminated by particulate matter, hydrocarbons, oxides of nitrogen, heavy metals and ground-level ozone.

Boards of health derive authority from several sources to regulate activities that cause air pollution or generate levels of noise that are detrimental to public health and welfare. Most of these regulations start with a general prohibition against the conduct of these activities in a manner that will "cause or contribute to a condition of air pollution."

DEP has formulated more specific standards for some of the activities within the jurisdiction of boards of health. For others, particularly dust and odor, a more subjective application of the above definition may be the only standard that local officials can apply.

When pollution is clearly originating from within municipal boundaries, the board of health (frequently with technical assistance from DEP) has primary enforcement authority. When emissions are originating from or having effects in neighboring municipalities, DEP enforces pollution standards.

DEP and the board of health may cooperate in collecting relevant data, and both have responsibilities relative to the assignment of sites for noisome trades that affect air quality.

NOISE CONTROL

Chronic or repeated exposure to excessive noise is recognized by public health experts as a hazard to both physical and mental health. It can cause a number of ailments including emotional stress, fatigue, high blood pressure and hearing loss. Damage to hearing from excessive noise can be permanent, as hearing loss cannot be restored with therapy.

The board of health is authorized to enforce DEP regulations, found at 310 CMR 7.10, that are intended to protect residents from exposure to excessive noise. In essence, these rules and DEP's policy for enforcing them say that no one may cause noise that exceeds normal ambient noise levels by more than ten decibels as measured on the A-weighted scale of a noise level meter that is properly calibrated to industry standards. Noise level measurements should be taken both from the property line and from the nearest inhabited residence.

DEP's noise regulations do not apply to locally permitted parades, public gatherings or sporting events _ provided they are not causing noise in a neighboring community _ nor to the operation of residential lawn and garden equipment between the hours of 7:00 a.m. and 9:00 p.m. Also exempted are civil defense, fire, police, medical emergency and military activities and vehicles.

Frequently Used Air Quality Terms

The following definitions are meant to provide an introductory understanding of air pollution terminology. These words or phrases are frequently used in official communications, notices or orders. Refer to DEP's Air Pollution Control Regulations (310 CMR 7.00) for a more complete dictionary of terms.

Aerosol means solid or liquid particles dispersed in a gas.
Air contaminant means any substance or man-made physical phenomenon in the ambient air space and includes, but is not limited to: dust, fly ash, fumes, gas, mist, noise, odor, radiation, radioactive material, smoke and vapor.

Air pollution means the presence in the ambient air space of one or more air contaminants in concentrations and for durations of time that:

$ Cause a nuisance; or

$ Are injurious or, based on available information, potentially injurious to human or animal life, vegetation or property; or

$ Unreasonably interfere with the comfortable enjoyment of life and property or the conduct of business.

Ambient air space means the unconfined space occupied by the atmosphere, including the air outside facilities or structures.

Chart means the Ringlemann Scale for grading the density of smoke as published by the U.S. Bureau of Mines in Information Circular No. 6888, or any other smoke inspection guide approved by DEP.

Emission means any discharge or release of an air contaminant into the ambient air space. Potential sources include, but are not limited to: combustion of fossil fuel, commercial or industrial facilities, furnaces, incinerators and open burning.

Fuel means any solid, liquid or gaseous material including, but not limited to, coal, gasoline, manufactured gas, natural gas, oil or wood that is used for the production of heat or power by burning.

Noise means sound of sufficient intensity and/or duration to be damaging, irritating or injurious.

Odor means any property of a gaseous, liquid or solid material that eleicits a response by the human sense of smell.

Smoke means the visible aerosol resulting from the combustion of materials. Smoke may include fly ash.

Board Of Health Responsibilities

Authority under M.G.L. c. 111, ss. 31, 31 C, 122 and 142 A through 142 M and DEP regulations found at 310 CMR 7.00.

The Board of Health:

$ Receives and responds to complaints about atmospheric pollution that is damaging, irritating or injurious.

$ Determines whether the source(s) of atmospheric pollutants are located within the municipality.

$ Orders the person(s) responsible to abate the offending emissions, provided the effects and source(s) are within the municipality and the authority of the board of health is clear.

$ Refers complaints to the applicable DEP Regional Director if the offending air pollution is originating outside the municipality.

In addition, it is recommended that the Board of Health:

$ Issue its own air pollution, noise, odor or noisome trade regulations as needed to address problems unique to the community. These rules may be issued under the authority of M.G.L. c. 111, s. 31 or s. 31 C. (Public hearings must be held prior to the promulation of new regulations or revisions to existing rules under the latter section. To be legally enforceable, these rules also must be submitted to DEP for approval.)

$ Keep on file current copies of DEP's Air Pollution Control Regulations (310 CMR 6.00-8.00) and the local Air Pollution Control District (APCD) Ambient Air Quality Standards for its own reference and public information purposes.

$ Channel information about local, state and federal air pollution standards and regulations to other municipal boards, commissions and departments (i.e. mayor or selectmen, planning, zoning, public works and conservation).

$ Put in place an emergency plan for communication with DEP's Commissioner and applicable Regional Director during episodes of air pollution that fall outside of local regulatory authority.

$ Maintain regular communications with special or ad hoc municipal or district committees organized to monitor air quality or advise regulators on air pollution control policy.

State Responsibilities

Carried out by the DEP Business Compliance Division, Air Branch, Business Compliance Division, Air Branch, One Winter Street, 9th Floor, Boston, MA 02108, (617) 292-5630; fax (617) 292-5778, and by the four DEP regional offices

Legal authority under M.G.L. c. 111, ss. 142 A through 142 M, and regulations including Ambient Air Quality Standards for the Commonwealth of Massachusetts (310 CMR 6.00), Air Pollution Regulations (310 CMR 7.00) and Regulations for the Prevention and/or Abatement of Air Pollution Incident Emergencies (310 CMR 8.00).

DEP is empowered to:

$ Adopt, amend and enforce regulations to prevent pollution or contamination of the atmosphere.

$ Operate and staff four DEP Regional Offices to enforce the above regulations. See 310 CMR 7.00 or page x of this Guidebook for listings of APCDs, DEP Regions and the municipalities within them.

Federal Responsibilities

Since air pollution is a problem that can be transported among municipalities, states and even countries, the U.S. Environment Protection Agency (EPA) maintains federal Air Quality Control Regions that are compatible with state APCDs to monitor air quality and enforce National Ambient Air Quality Standards pursuant to the Clean Air Act, as amended in November 1990.

CHAPTER 12: Indoor Air Quality

BOARD OF ROLE AT A GLANCE

Local Boards of Health (BOH) derive jurisdiction over indoor air quality in buildings from several sources depending on the type of building involved. In general BOH have authority to enter public buildings, buildings that the public may enter and homes under various Massachusetts statutes and regulations to investigate public nuisance (M.G.L. c. 111 sec. 122). Once the type of building is identified (e.g., residential, commercial or government buildings), the board of health should be able to respond to provide information concerning indoor air quality and conduct information gathering concerning the issues surrounding the complaint. Once information is gathered to identify that an indoor air quality problem exists in a building, the BOH should refer this complaint to the Bureau of Environmental Health Assessment at the Department of Public Health (DPH). BEHA will respond to the complaint referrals by conducting an assessment of the complaint.

OVERVIEW OF INDOOR AIR QUALITY

Indoor air quality in buildings can be a vexing problem for boards of health for a number of reasons. These difficulties can be organized into the following general categories.

1. Symptoms that are reported by building occupants are usually non-specific.
2. No obvious source of exposure to environmental materials is readily observable to the health agent.
3. Investigation of indoor air quality problems can require specialized knowledge concerning ventilation and heating systems; building maintenance and engineering; microbiology, toxicology; industrial hygiene practices and other areas outside the normal scope of activities of a board of health
4. The BOH is frequently asked to investigate the conditions of the building after a substantial time has past since the initial complaints from building occupants/the general public.
5. Building occupants expect that the reported problems can be fixed instantly upon investigation, even when conditions in a building may result in substantial modifications to a building.
6. There are no unified environmental statutes, regulations, or standards that may be referred to ascertain whether a building has a bona fide indoor air quality standard.

Each of these factors can place both the board and health agent in a difficult position to evaluate reported "sick building syndrome." In the experience of BEHA, indoor air quality problems generally fall into three general categories:

1. Heating, ventilating, and air-conditioning (HVAC) function;
2. Microbial growth indoors
3. Indoor/outdoor sources of respiratory irritants/vapors/gases/particulates.

HVAC systems

The HVAC system in a building is usually designed at a minimum to provide heat during cold weather. The State Building Code requires buildings to meet certain minimal standards for ventilation prior to the issuance of a certificate of occupancy by the building inspector. These minimal standards can be used to ascertain whether the HVAC system in a building is functioning adequately. The Massachusetts Building Code requires a minimum ventilation rate (see Table 1 for examples by buildings) of fresh outside air or have openable windows in each room (780 CMR 1209.0; SBBRS, 1997; BOCA, 1993). Chapter II of the State Sanitary Code has a similar requirement in that a domicile must have windows that open to a minimum of 4 percent of the floor area or have mechanical ventilation capable of exhausting air (see Table 2) (105 CMR 410.280; MDPH; 1997).

Table 1 Required Mechanical Ventilation Air[a] in Frequently Encountered Building Spaces/Areas

Facility/Area Type	Outdoor air [cubic feet per minute (cfm) per occupant]
Classrooms	15
Auditoriums	15
Dining rooms	15
Libraries	15
Gymnasiums	20
Laboratories	20
Office spaces	20
School Training Shops	20
Beauty salons	25
Commercial dry cleaners	30
Smoking lounges [b]	60
Dark Room	0.5 cfm per square foot of floor space
Swimming Pools (pool and deck area)	0.5 cfm per square foot of floor space
Pet Shops	1 cfm per square foot of floor space
Public Restrooms [b]	75 cfm per water closet or urinal

[a] BOCA National Mechanical Code-1993

[b] exhaust ventilation required

Table 2 Mechanical Ventilation Rates for Residences Required Air Changes 105 CMR 410.280

Type of Room	Required Air Changes per Hour by Mechanical Exhaust Ventilation System
Habitable Room [a]	2
Bathroom	5
Toilet Room	5
Shower Room	5

[a] Other than bath, toilet of shower rooms

The reason why an HVAC system is not providing adequate fresh air or exhaust ventilation can be numerous. Disabled components to save on energy costs, poor placement of air diffusers, lack of preventative maintenance, blockage of vents by building occupants are but a few of the problems that are frequently identified by BEHA staff during assessments. An operable HVAC system is important for providing comfort for building occupants. All buildings normally accumulate dust, gases, vapors or other pollutants indoors. People produce water vapor, waste heat, carbon dioxide and shedding skin cells. The HVAC system can also serve the purpose to reduce pollutant concentrations in the indoor environment. By introducing fresh air into a fixed volume space (e.g., a room), the pollutants are diluted into a larger volume of air. Dilution means a decrease in air concentration, which would also decrease the dosage of pollutants to room occupants. With reduced exposure to pollutants, a reduction or elimination of symptoms in room occupants should occur. Frequently, the HVAC system will also have an exhaust vent, which physically removes pollutants from the room. The actions of dilution and removal by a properly functioning ventilation system will reduce exposure to environmental pollutants while creating airflow and generating heat in a room.

Identifying the components of the ventilation system in any building is key to understanding how indoor air quality can be negatively impacted. Unfortunately, HVAC system designs can vary widely depending on the purpose of the building (residential, commercial, or government), the age of the building, the components of the ventilation system and the HVAC design. Understanding each of these aspects of a building's HVAC system is essential to address possible source of environmental pollutants that may be in a building.

Microbial Growth

A second general area that can have a pronounced negative impact on indoor air quality in a building is mold and other microbial growth. At a bare minimum the following conditions are necessary to support mold growth in an indoor environment:

1. mold spores;
2. nutrients necessary to support a mold proliferation;
3. adequate temperature; and
4. moisture.

Of these general conditions, moisture is the only condition that can be realistically controlled in the indoor environment to prevent mold growth. Chapter II of the State Sanitary Code has several sections that are related to the prevention of microbial growth in a building.

1. Windows, doors and other structural elements be rendered weather tight (105 CMR 410.501, MDPH; 1997)

2. Rooms cannot be used for habitation that is subject to chronic dampness and has more than ½ of its floor to ceiling height below the average grade of the surrounding ground (105 CMR 410.402, MDPH; 1997).
3. Requirements for a smooth, non-corrosive, non-absorbent waterproof covering for floors in toilets, showers, kitchens and pantries 105 410.504, MDPH, 1997).

Each of these sections of the State Sanitary Code is an example of methods that can be used to prevent moisture accumulation in materials that can support mold growth. These concepts can be used and applied to any structure that is experiencing indoor mold growth. Identification of the mold colonized materials and removal is an important first step to reduce possible indoor air pollutants. Of more importance is to identify the source of the moisture that is moistening the mold-colonized materials. Replacement of moldy materials without identification and repair of the source of moisture would be expected to eventually result in new mold growth on the replaced building component. Non-porous materials can be salvaged with the application of an appropriate antimicrobial agent (1 part to 10 parts bleach solution) and subsequent cleaning with soap and water. Examples of non-porous materials are cement, tile, metal, stone, and some hard plastic surfaces. Porous materials, such as paper, cloth, cardboard, ceiling tiles, carpeting, insulation and other related materials are more difficult to remediate. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Once water-damaged, nonporous materials cannot be adequately cleaned to remove mold growth without extraordinary means that can be time consuming and expensive.

Indoor/Outdoor Sources of Respiratory Irritants/Vapors/Gases/Particulates

This general category encompasses a large number of materials that can create indoor air quality complaints. Table 3 lists general source for these materials that can serve as sources of vapors/gases/particulates exposure that can produce acute symptoms that can quickly resolve after leaving a building. These materials if used without

Table 3 Potential Sources of Indoor Air Pollutants

building renovations	mimeograph machines	water heaters
vocational shops	chemical storage	air fresheners
art rooms	new furniture	dry cleaning solvents
pottery kilns	carpeting	nail application solvents
custodial products	lamination machines	spray paint
pesticide applications	school/clerical supplies	spray on artificial snow
vehicle exhaust	fuel oil vapors	dry erase markers
wood stove smoke	sewer gas from dry traps	dry erase board cleaners
photocopier	janitorial supplies	chalkboards

adequate ventilation, poor hygiene practices, poor storage or inadequate maintenance can result in a build up of air concentrations of constituents of these products. Identification, reduction of air levels or elimination of the source of these materials can serve to improve indoor air quality.

The key to identifying indoor air quality problems in buildings are the recognition that usually indoor air quality are not the result of a single cause, but are usually a combination of conditions that interact to degrade a building's environment.

BOARD OF HEALTH RESPONSIBILITIES

The BOH must ensure that homes meet the standards set forth in the State Sanitary Code Chapter II, 105 CMR 410.000, Minimum Standards of Fitness for Human Habitation. In commercial or public buildings, the BOH has the authority to investigate public nuisances M.G.L. c. 111 sec. 142.

STATE RESPONSIBILITIES CONCERNING GENERAL INDOOR AIR QUALITY ISSUES

The MDPH has the statutory responsibility to "conduct sanitary investigations and investigations as to the cause of disease...and shall advise the government concerning the location and other sanitary conditions of any public institution" (MGL c. 111 sec. 5). To meet this responsibility with regard to indoor air quality, requests are referred to the Emergency Response/ Indoor Air Quality (ER/IAQ) Program for assessment. After a preliminary evaluation by the ER/IAQ staff, an assessment will be scheduled for the building of concern or a referral is made to the appropriate state agency. After the indoor air assessment is completed, a report with recommendations for remediating the problem and a letter of transmittal is sent to the BOH, state and local government officials and/or the party requesting the survey.

Where IAQ assessments require further follow-up beyond indoor air quality assessment, other programs within BEHA may become involved in a building assessment. BEHA has a broad mission of protecting the public health from a variety of environmental exposures, including general indoor air quality, radon and asbestos. The BEHA responds to environmental health concerns and provides communities with epidemiological and toxicological health assessments.

BOH may contact BEHA to request technical assistance concerning indoor air quality complaints or to request an indoor air quality investigation of public buildings.

For more information contact:
Indoor Air Quality Program
Bureau of Environmental Health , Massachusetts Department of Public Health
(617) 624-5757

In some specific cases, statutes were enacted or regulations promulgated to regulate the following indoor air quality pollutants:

1. Radon;
2. Lead;
3. Asbestos;
4. Formaldehyde off-gassing from urea formaldehyde foam insulation (UFFI); and
5. Carbon monoxide and nitrogen dioxide in indoor ice skating rinks.

Regulations with regard to each of these pollutants require specific actions by the BOH and various state agencies.

OVERVIEW OF RADON

Radon is a naturally occurring radioactive gas found virtually everywhere. The colorless, odorless and tasteless gas is produced as part of the inevitable decay process of natural uranium found in the earth's crust. Radon and its progeny represent the single largest source of radiation exposure to the population of the United States.

Radon is an inert gas with the ability to be transported through the tiny spaces found in soil. Radon, in turn, produces a series of charged, chemically reactive particulates, which are also radioactive. When inhaled, these radon progeny are trapped in the lung where they will irradiate sensitive tissue, sometimes resulting in lung cancer.

Health Effects - Evidence
The U.S. Environmental Protection Agency (EPA) states that somewhere between 7,000 and 30,000 people will die this year from radon induced lung cancer. The central estimate of annual fatalities is about 14,000 people. Unlike most chemical hazards, radon is classified as a "known human carcinogen." The evidence for this unusually definitive classification comes from research studies, principally from populations of workers occupationally exposed to radon in various mining operations.

Radon in Massachusetts Homes
Concentrations of radon gas are typically expressed in terms of its radioactivity, in units of picocuries per liter of air (pCi/L). A picocurie is a unit of radioactivity equivalent to about 2 atomic transformations each minute. In the case of radon, each transformation results in an emission of alpha radiation. Radon decay product concentrations are reported in "working levels" (WL). In a typical home it takes about 200 pCi/L of radon to produce one working level. A screening value of 4 pCi/L or greater, indicates that the home has "potential to exceed" the EPA Action Guide of 4 pCi/L annual average exposure. About 1 in 4 homes in Massachusetts falls into this "potential to exceed" category, while slightly over 1% (or about 29,000 homes) exceeds 5 times that value (20 pCi/L).

<u>1988 Massachusetts Radon Survey (completed March 1988)</u>
1650 Homes Screened
23 .9 % > 4 pCi/L
1.3 % > 20 pCi/L
Median Value 1.9 pCi/L

Exploring the distribution by county, reveals that residents of three counties have an even greater probability of living in a home greater than 4 pCi/L, with homes in Worcester county having nearly a 40% chance of having screening values of 4 pCi/L or more.

Massachusetts State Radon Survey, Results By County

Percent Of Homes Screening At 4 pCi/L Or More

County Name	%
WORCESTER	38
ESSEX	36
MIDDLESEX	26
BRISTOL	23
FRANKLIN, HAMPSHIRE	23
BERKSHIRE	21
NORFOLK	21
BARNSTABLE	15
PLYMOUTH	12
HAMPDEN	11

It would be most beneficial to be able to characterize homes that are more likely to have high radon levels. Unfortunately this is not possible. Parameters such as: house age, construction styles, building materials, use of private well water and energy efficiency, have not been linked to high radon levels.

Any given house in Massachusetts has a chance of between 1 in 10 and 4 in 10, of having a radon screening result of 4 pCi/L or greater, depending on which county the home is located in. The average risk for the whole state is about 1 in 4, or 25% . Given the large number of homes potentially affected and since we have no way of knowing which houses are affected, all buildings should be tested. Homes above the third floor and those built on pilings, without contact with the ground or private water systems could be reasonably excluded.

According to EPA's Radon Program, an annual average exposure of 4 pCi/L carries an average risk to the U.S. population of 1 to 5 percent over a lifetime. The risk to smokers is considerably higher than nonsmokers. Every credible consensus group, including, the National Commission on Radiation Protection and Measurements, the International Commission on Radiation Protection and the National Academy of Sciences BEIR group, are in strong agreement on the risk values

Testing Strategies

Selection of a testing method depends to a large extent on circumstances such as, availability of time, the season, and control of testing conditions. There is no "best" test. Selection of a testing method should be guided by the goals of the measurement, constraints imposed by the particular building under consideration and the time available for testing.

Testing methods can be categorized as "long term" or "short term," and "active" or "passive."

Long term measurements, conducted with the goal of estimating long term (annual average) exposure, are theoretically believed to yield results closer to the actual long term radon level than short term measurements.

Short term tests (2 to 7 days) are employed with the primary goal of quickly separating those homes that "don't have a radon problem" from those that "might have a radon problem." The conditions during the test should be considered when interpreting the results.

Passive detectors are far less expensive than active, high tech, sampling systems. The use of short term, passive devices like those using charcoal or electret technologies, allow multiple locations within a building to be sampled simultaneously. Concurrent measurements can be quite useful in evaluating complex houses as well as validating the measurements themselves. Further, they provide a more informed, confident basis upon which to make a serious financial decision.
Charcoal detectors can be purchased for about $15 to $20 each individually.

Active sampling provides the ability to follow short term trends such as diurnal cycles and occupancy related effects. Due to the expense of this type of sampling however, the devices are often removed before these effects can be adequately studied. Purveyors of active sampling services are confident in their ability to detect accidental or intentional tampering with the measurement conditions (i.e., opening windows). While this claim is not totally unjustified, there is no technique which is immune from the sophisticated individual intent on deception.

How Radon Enters the Home
Radon can enter the home anyplace where the house touches the ground and there is a hole in the house. An atom is a small thing, so even the tiniest of holes could allow entry. Examples of radon entry pathways include: the floor/wall joint, sump holes, utility penetrations, spaces under basement toilets, tubs or showers, voids in block walls, spaces between fieldstone or brick in walls, hollow lally columns and emanation from water use (private groundwater systems only).

Water (from private well water systems), contributes to indoor radon exposure by acting as a transport mechanism, delivering radon gas to the point of use, indoors, where it is liberated to the air. Inhalation of radon gas is the critical pathway. When one considers the radiation doses committed as a result of drinking radon rich water versus inhaling the radon liberated from that same water, doses delivered to the lungs always dominate.

Each 10,000 pCi/L in water results in about 1 pCi/L added to the average indoor air.

Why Radon Enters the Home
The lower level(s) of most houses operate in a depressurized state relative to the outside, including the surrounding soil. This depressurization literally sucks radon from the surrounding soil into the house. The radon concentration inside the home depends on the radon entry rate and to a lesser extent the air exchange rate. There is no relationship between energy efficiency and occurrence of radon problems. The radon entry rate is a function of the number and size of the entry pathways, the amount of depressurization or suction, the amount of radon in the surrounding soil and the porosity of that soil.

There are three major factors which drive the depressurization of the house. First, warm air tends to rise from the bottom towards the top of the house. As this air moves upward a vacuum is created at the bottom. This is called the stack effect and is driven by the differences in temperature both within the house and between the indoors and outdoors. Along with this virtual stack, many homes with flues (used or unused) have actual stacks removing air from the lower levels of the home resulting in depressurization. The next major factor is the combustion effect. When wood or fossil fuels are burnt in the home, a significant amount of air is involved in the process. About 130 cubic feet of air per minute goes out through the chimney during combustion. Wind also plays an important role in house depressurization. The windward side of a house tends to be pressurized, while the lee side is depressurized. Variation in the wind speed or direction may cause a pumping action. The wind effect is quite noticeable when conducting radon diagnostics during mild weather when the other effects are at their minimum. In addition, appliances which discharge air to the outside of the building also result in depressurization. Some examples of those include, whole house or attic fans, bathroom fans, clothes dryers and range hoods.

Mitigation Strategies

The options for radon mitigation fall into two major categories: those strategies that prevent radon entry into livable spaces and those that attempt to remove radon already inside livable spaces. The optimization of a radon mitigation system in a particular building requires careful evaluation of competing values. Informed use of diagnostic tests is a key element in the process of balancing potentially competing objectives.

Treating Radon Contaminated Air Through Ventilation

Doubling the fresh air infiltration rate of a building will, theoretically, reduce the indoor radon concentration by one half. This assumes that the air is moved into, rather than exhausted from the building. Exhausting air will cause further depressurization of the building, resulting in an increased radon entry rate. This usually results in increasing rather than decreasing the radon concentration.

Ventilation using heat recovery ventilators (HRV's), can be effective when the area to be treated is small, the air infiltration rate is initially low and the radon concentrations are relatively modest (less than 10 pCi/L). While the initial costs of HRVs and soil depressurization systems are comparable, HRV's have an associated "energy penalty."

Preventing Radon Entry

Sealing small floor and wall cracks generally does little to reduce radon levels in houses. In order to be effective, virtually every tiny opening to the soil must be plugged. Further settling may reopen them or create new ones. Large openings to soil, like sump holes, utility access pits, etc., may be significant sources of indoor radon. A quick and inexpensive evaluation of the effectiveness can be obtained by temporarily sealing large openings with tape and/or plastic. Radon tests conducted before and after this temporary sealing will provide some measure of effectiveness.

Experienced mitigators do not have much confidence in sealing alone as an effective mitigation strategy. Sealing of large openings may, however, enhance the operation of other mitigation strategies.

Soil Depressurization

Soil depressurization strategies are the most common and most effective technologies for radon mitigation. Using sub slab, block wall, drain tile and membrane depressurization strategies, radon reductions in excess of 95% are common.

In sub-slab depressurization, a pipe that penetrates the slab or concrete basement floor is run, usually up through the inside of the house, to the roof. The pipe is equipped with a suitably sized blower located in the attic or outside on the roof. The blower draws air from the soil beneath the building creating a plane of low pressure under the foundation. Air inside the building will be then be drawn out to the soil through the now former radon entry paths.

Drain tiles and sump pump openings may also be depressurized as additional variations of soil depressurization technology. For dirt floor crawl spaces, a rubber or plastic membrane may be installed and fitted with duct and blower as described above.

Foundation walls, constructed of concrete blocks, may require the blocks themselves to be depressurized. If the voids inside the blocks are open, those in the top course may need to be filled with concrete or expanding foam.

Because soil depressurization systems draw radon directly from the soil, they contain extremely high radon concentrations. Radon concentrations (inside the system) vary between a few hundred to a few thousand picocuries per liter. A typical soil depressurization system discharges well in excess of one million picocuries each minute to the outdoors. For these reasons, the design and installation of soil depressurization systems is of utmost importance. Building occupants must be protected from leaks inside living space and re-entry of discharged radon.

BOARD OF HEALTH RECOMMENDED ACTIVITIES

Although the BOH does not conduct radon testing, the following are recommended:

- conduct radon educational awareness activities within the community and encourage homeowners to test for radon;
- arrange public meetings and training sessions on radon;
- arrange for radon testing of schools and public buildings.

OVERVIEW OF ASBESTOS

The term asbestos refers to a variety of naturally occurring mineral silicates. This flexible fibrous material is incombustible, has tensile strength, and has many desirable thermal and electric insulating properties. Asbestos has been used in roofing and flooring materials, textiles, papers, filters, cement, panels, pipes, coating material, and thermal and acoustic insulation. Although many materials contain asbestos, the amount of fibers naturally released is small in comparison to the exposure that can potentially result from disruption of the material. Material that has been applied through a spraying process may be more susceptible to fiber release.

A report issued by the Environmental Protection Agency in 1988 reported that 733,000 public and commercial buildings contained asbestos. The concentration of airborne fibers is reported to range from 0 to over 100 fibers/ml of air, depending on the condition of the asbestos containing material and the proximity of activity. However, a study of 49 government buildings in 1989 found that while airborne asbestos levels in buildings containing asbestos are slightly elevated over the values of building that do not contain any asbestos, all asbestos levels were low enough as to not warrant concern.

The DEP regulation on asbestos (310 CMR 7.15) prohibits demolition/renovation, installation, reinstallation, handling, transporting, storage or disposal of a facility or facility component that contains asbestos which causes or contributes to a condition of air pollution.

The regulation requires that the owner/operator of any demolition/renovation project involving asbestos-containing material, notify DEP and follow specified procedures for controlling asbestos emissions using air cleaning equipment and proper disposal. All of these provisions, except notice to DEP, are enforceable by the board of health. (Benes, et al., 1995). Anyone needing further information can contact the DEP Info Line at (617) 338-2255 for greater Boston and 1-800-462-0444 for elsewhere in the state.

Two commonly asked questions relative to asbestos:

Q. Are asbestos cement siding tiles/shingles harmful?

A. These products are not likely to release asbestos fibers unless drilled, scraped, sawed or cut.

Q. Is there any concern relative to the removal of sheet and tile flooring?

A. Sanding asbestos containing tiles can release fibers. So may the sanding or scraping of the backing of sheet flooring during removal. Unless new flooring can be installed directly over the old material, removal must be done by a certified contractor.

Health Effects - Evidence

Asbestos exposure in the home and occupational setting has been demonstrated to cause four distinct diseases: asbestos (a non-malignant searing of the lung tissue), bronchogenic carcinoma (a malignancy of the lining of the air passages), mesothelioma (a diffused malignancy of the lining of the chest cavity), and possibly cancers of the stomach, colon, and rectum. Residents of a building constructed with asbestos containing materials are unlikely to develop severe adverse health effects such as asbestosis or cancer as the exposures are too low. However, situations of remodeling or renovation where the asbestos containing material is likely to be disturbed could result in significant exposure. The risk of lung cancer and mesothelioma increase with the number of asbestos fibers inhaled. This risk also increases in individuals who smoke. Symptoms of asbestos exposure usually do not manifest themselves until about 20 to 30 years after the first exposure. Most people are exposed to some amount of asbestos in daily living and do not develop health problems. However, once asbestos fibers are inhaled into the lungs, they remain there for extended periods of time, thereby increasing the risk of disease. Asbestos material that crumbles easily or that has been sawed, scraped, or sanded into a powder, is more likely to create a potential health hazard.

Common locations of asbestos include:

a. Steam pipes, boilers, and furnace ducts insulated with asbestos
b. Resilient floor tiles, vinyl sheet flooring, and adhesives on the backing of vinyl
c. Cement sheet, millboard, and paper used as insulation
d. Door gaskets on furnaces, wood burning stoves, and coal stoves
e. Soundproofing or decorative material sprayed on ceilings and walls
f. Patching and joint compounds for walls and ceilings, and textured paints
g. Asbestos cement roofing, shingles, and siding
h. Artificial ashes and embers used in gas fireplaces
I. Automobile brake pads and linings, clutch facings, and gaskets

Most products manufactured today do not contain asbestos, and those products that do are labeled as such. However, products manufactured prior to 1970 should be checked for asbestos content.

Solutions

The best solution for dealing with intact asbestos containing material is to leave it alone. If the material is in good condition (non-friable) and not flaking or crumbling, it will probably not release asbestos fibers. Homeowners are required by 105 CMR 410.000 to maintain asbestos pipe lagging and boiler insulation in a non-friable condition. If the asbestos is intact, inspect it regularly for signs of damage, such as tears, abrasions or water damage. Take care to avoid rupture or other damage to the asbestos containing material.

If the asbestos material is damaged, repair or removal is necessary. This is a costly process and generally can only be conducted by asbestos abatement contractors certified by the Department of Labor and Workforce Development.

For additional information contact:

US Consumer Product Safety Commission, Washington, D.C. 20207
1-800-638-CPSC or (TTY) 1-800-638-8270

Local Chapter of the American Lung Association

Environmental Protection Agency, Indoor Air Quality Information Clearinghouse
1-800-585-4318

BOARD OF HEALTH RESPONSIBILITIES

- The BOH must ensure that asbestos in residential homes meets the standards set forth in the State Sanitary Code, Chapter II, 105 CMR 410.353, Asbestos Material. The BOH has the responsibility to order the correction of any damaged asbestos.

- Any questions the BOH may receive from the community concerning asbestos removal or asbestos in commercial buildings, should be referred to the Department of Labor and Workforce Development or the Department of Environmental Protection.

STATE RESPONSIBILITIES

BEHA has a broad mission of protecting the public health from a variety of environmental exposures, including radon and asbestos. The BEHA responds to environmental health concerns and provides communities with epidemiologic and toxicological health assessments and is one of the few state agencies capable of conducting indoor air quality assessments. Requests for assistance in evaluating indoor air quality problems are referred to the Indoor Air Coordinator for an assessment. After a preliminary evaluation by the environmental engineering staff and BEHA follow-up, jurisdiction for the problem is determined and referral to the appropriate state agency is made. After an indoor air quality evaluation is completed, a report with recommendations for resolving the problem and a letter of transmittal is sent to the BOH and/or the party requesting the survey.

Boards of Health may contact BEHfor the operational protocol for conducting indoor air quality assessments. For more information contact:

Bureau of Environmental Health, Massachusetts Department of Public Health
(617) 624-5757

Radon information:
Radiation Control Program, Bureau of Environmental Health, Massachusetts Department of Public Health
(617) 242-3035

Asbestos information:
Department of Environmental Protection (617) 292 - 5630
Department of Labor and Workforce Development (617) 727 - 7047

OVERVIEW OF UREA FORMALDEHYDE FOAM INSULATION (UFFI)

Formaldehyde (HCHO) is a colorless volatile gas with a pungent odor and high water solubility. Formaldehyde in the home can be derived from a number of sources such as paper products, floor coverings, carpet backings, adhesives, particle board, cigarette smoke, various synthetic resins, and combustion processes. In the office environment, furniture, furnishings, and carbonless copy paper are additional sources. However, public awareness of the potential health hazards of formaldehyde arose from the use of urea formaldehyde foam insulation (UFFI) in as many as 200,000 homes in the United States.

UFFI is an insulation made of urea formaldehyde resin and a foaming agent, pumped into the walls and ceiling. Formaldehyde in the insulation, even if properly installed, reacts with heat and humidity in the air. This allows formaldehyde gas to be released into the air of a UFFI-insulated building. This type of insulation, popular during the energy crisis of the 1970's, was banned in Massachusetts in November 1979.

The off-gassing of formaldehyde from sources inside the home led to elevated concentrations in the indoor environment. Measurements of the concentration of formaldehyde inside homes insulated with UFFI found elevated levels over homes without UFFI (0.05-0.07 ppm as compared to 0.022-0.036 ppm). This is especially true in mobile homes, which tend to have greatly increased concentrations of formaldehyde over conventional homes. Office buildings have been found to have elevated formaldehyde concentrations in the range of 0.1-0.3 ppm.

Health Effects - Evidence

Formaldehyde gas can cause health problems in sensitive individuals including infants, the elderly, people with respiratory disease (such as asthma), and people who have allergies. Undesirable health effects may include sore throat or nose, difficulty breathing, nosebleeds, headaches, laryngitis, nausea, skin or eye irritations, fatigue, or dizziness. There are no reported acute health effects associated with formaldehyde concentrations less than 0.05 ppm. However, the high degree of UFFI water solubility leads to irritation of the upper respiratory system and eyes at levels of 0.05-0.1 ppm. Lower respiratory effects are usually not present until concentrations exceed 5.0 ppm. All of these levels are subject to a large degree of individual variability. Many questions remain concerning the chronic health effects of formaldehyde exposure. A positive association between nasal cancer and formaldehyde exposure has also been documented. EPA has determined that formaldehyde is a probable human carcinogen. Formaldehyde has been investigated as a risk factor for other cancers such as lung, buccal pharyngeal, brain, prostate, skin, kidney, and digestive system. Formaldehyde has been associated with chronic decrease of lung function and asthma. Formaldehyde exposure in the home and in the office has also been linked with a prevalence of neuropsychological symptoms such as headache, memory lapse, fatigue, and insomnia.

BOARD OF HEALTH RESPONSIBILITIES

Provide information to residents and businesses on health concerns related to formaldehyde/UFFI.

OVERVIEW of Carbon Monoxide and Nitrogen Dioxide in Indoor Ice Skating Rinks

Requires indoor skating rink operators to conduct air sampling, keep records of sampling results, maintain records, apply for and obtain a certificate of approval from the local board of health.

These regulations were effective March 21, 1997. No ice rink may operate with a certificate of approval after May 26, 1997.

Air Monitoring for Carbon Monoxide and Nitrogen Dioxide Testing
A rink operator must test the indoor air of their rink for carbon monoxide and nitrogen dioxide three times a week, twice during the weekdays and once on the weekend. The testing consists of one air sample for carbon monoxide and nitrogen dioxide to be done twenty minutes after resurfacing. Testing must be done between 1-4 hours prior to closing.

- If an air sample exceeds 30 ppm for carbon monoxide or 0.5 ppm for nitrogen dioxide, the ice rink operator must take positive measures to decrease air concentrations of these contaminants below these standards as described in 105 CMR 675.009.
- If an air sample exceeds 30 ppm for carbon monoxide or 0.5 ppm for nitrogen dioxide for six (6) consecutive air samples, the ice rink operator must notify the local fire department, local BOH and the Bureau of Environmental Health Assessment within 24 hours of sampling in addition to taking all actions required by 105 CMR 675.009.
- If an air sample exceeds 60 ppm for carbon monoxide or 1 ppm for nitrogen dioxide, the ice rink operator must notify the local fire department, local BOH and the Bureau of Environmental Health Assessment within 24 hours of sampling.
- If an air sample exceeds 125 ppm for carbon monoxide or 2 ppm for nitrogen dioxide, *THE ICE RINK OPERATOR MUST EVACUATE THE RINK*, notify the local fire department, local BOH and the Bureau of Environmental Health Assessment.

If an indoor ice rink does not use ice resurfacing equipment that produces carbon monoxide or nitrogen dioxide (e.g., electric), that the ice rink operator does not have to comply with these regulations. It is recommended that the operator who operates electric powered ice resurfacing equipment file the ice rink application with the local board of health for documentation purposes.

BOARD OF HEALTH RESPONSIBILITIES
The BOH authority is denoted at 105 CMR 675.000 *Requirements To Maintain Air Quality In Indoor Skating Rinks* (State Sanitary Code, Chapter XI). The regulations require all ice rinks subject to these regulations to have a current Certificate of Approval from the local BOH. The Certificate of Approval must be renewed annually. No ice rink subject to these regulations may operate without a valid Certificate of Approval. The Certificate indicates that the ice rink has met all requirements in the regulations for record keeping, reporting and air monitoring with adequate and functioning equipment.

The following are responsibilities assigned to the BOH under these regulations.

1) Receive an application for a Certificate of Approval from Ice Rink from the ice rink operator, who is required to conduct testing under 105 CMR 675.000.
2) Determine that acceptable air monitoring devices are being utilized. For measuring carbon monoxide air levels colorimetric tubes, in place monitors with a digital read-out, hand held monitors or computer chip sampling devices are acceptable. Air monitoring devices acceptable for measuring nitrogen dioxide air levels are colorimetric tubes, or computer chip sampling devices.
3) Ensure that air samples are taken at the proper locations. Air samples must be taken either at center ice or the perimeter of the ice surface at the center ice line at a height between three to six feet.

4) Inspect record keeping log for compliance with regulations. The operator must keep a paper record keeping log with the following information:
   a) the name and address of the indoor skating rink;
   b) sample results, time and date of sampling, location of sampling, the name and method of the device used during sampling, and name with signature of individual conducting monitoring;
   c) date of the air sampling device calibration, the name and signature of individual conducting air sampling device calibration;
   d) ice resurfacer tuning date(s) and name with signature of individual conducting tuning shall be denoted in the record keeping log; and
   e) the name of the manufacturer, type and date of installation of catalytic converter equipment, with the name and address of the individual or group of individuals who performed the catalytic converter installation, shall be denoted in the record-keeping log.
5) Order facility(s) not in compliance with 105 CMR 675.000 to abate non-compliance issues in order to obtain certificate of approval.
6) Issue a Certificate of Approval for Ice Skating Rinks in Compliance with 105 CMR 675.009.
7) Send copy of certificate of approval and/ or materials from the rink in the form of an application, renewal or other related materials to the BEHA.

STATE RESPONSIBILITIES

The BEHA has the following responsibilities.

1) The Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) shall, upon request of the board of health, assist the board in its inspection of an indoor skating rink and shall advise the board in connection with enforcement actions taken by the board against a skating rink operator.
2) The Bureau may from time to time issue written interpretations and guidelines as necessary to promote uniform application of 105 CMR 675.000.
3) The Bureau may grant variances of applications on any provision of 105 CMR 675.000 with respect to any particular case. Every request for a variance shall be in writing and shall state the specific variance sought and the reasons therefore.

Whenever any board of health has failed after a reasonable length of time to enforce 105 CMR 675.000, the Department may enforce 105 CMR 675.000 in any way that a local board of health is authorized to act to effect compliance under 105 CMR 675.000.

BOH may contact BEHA to request technical assistance concerning ice rink regulation compliance; to obtain copies of applications, inspection sheets and/or Certificates of Approval; or to request a joint inspection of an ice rink.

For more information contact:
Indoor Air Quality Program
Bureau of Environmental Health
(617) 624-5757

References for General Indoor Air Quality

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

MDPH. 1997. Minimum Standards of Fitness for Human Habitation (State Sanitary Code, Chapter II). Code of Massachusetts Regulations. 105 CMR 410.000.

MGL c. 111 sec. 5. Powers and Duties of the Department [of Public Health].
MGL c. 111 sec. 122. Regulations Relative to Nuisances; Examinations.
SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0
References for Ice Rink Regulations

MDPH. 1997. Requirements to Maintain Air Quality in Indoor Skating Rinks (State Sanitary Code,

Chapter XI). 105 CMR 675.000

Internet Links

http://www.state.ma.us/dep/bwp/daqc/daqcpubs.htm#regs
DEP Air Quality Reports and Regulations
Indoor Air Quality Reports by Community
Indoor Air Quality Unit