

BUSINESS COUNCIL ON INDOOR AIR

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BUSINESS COUNCIL ON INDOOR AIR

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August 6, 1993

Mr. Brian Burke
Domestic Policy Council
Old Executive Office Building, Room 210
The White House
Washington, D.C. 20503

Dear Mr. Burke:

Thank you for your interest in arranging a meeting with key staff in your office. As you requested, enclosed are the following BCIA materials that describe our views on the federal government's role in addressing indoor air quality:

- (1) A white paper entitled, "Building-Systems Approach to Indoor Air Quality," which outlines BCIA's technology-based method of improving indoor air quality;
- (2) BCIA's comments pursuant to OSHA's 1991 Request for Information on indoor air quality;
- (3) May 25, 1993 testimony before the Senate Subcommittee on Clean Air and Nuclear Regulation on S. 656, The Indoor Air Quality Act of 1993, and a follow-up letter to the Subcommittee.
- (4) A list of our members.

I will send you a list of probable attendees at the meeting as soon as I learn the date. Thank you again for your assistance.

Sincerely,

Paul A. Cammer, Ph.D.
President

Enclosures



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BUILDING-SYSTEMS APPROACH TO INDOOR AIR QUALITY

Executive Summary

It is generally believed that the vast majority of cases of poor indoor air quality are the result of energy-saving practices implemented since the 1970s, coupled with the inadequate design, operation and maintenance of ventilation, filtration, and other building systems. In studies of hundreds of buildings, the most common factors affecting indoor air quality were found to be poor ventilation, poor air filtration, and poor operation of building ventilation systems.

The building-systems approach to indoor air quality is a comprehensive, continuing process that promises to improve air quality indoors with a minimum of expense and regulatory intrusion. In the case of new buildings, this approach commences at the building-design stage, continues through the construction and commissioning stages, and includes proper operator training and effective building operation and maintenance throughout the entire life of the building. For existing buildings, it includes testing, maintenance, and possible redesign of ventilation, filtration, heating, and air conditioning systems. In either case, the building-systems approach incorporates the principles of a number of American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) standards and guidelines, including ASHRAE Standard 62-1989 regarding ventilation rates for acceptable indoor air quality. It also requires the use of appropriate design criteria and construction documentation, and the provision and implementation of operation and maintenance procedures to ensure the health and comfort of building occupants.

The Business Council on Indoor Air (BCIA) considers the building-systems approach to be an important management tool that should be applied to both existing and planned buildings to provide good indoor air quality. BCIA

recommends that future regulatory approaches to indoor air include provisions for optimal air exchange and filtration and proper management of building systems. Because of its potential to address the majority of potential indoor air quality problems in the most cost effective way, the building-systems approach should receive high priority in federal or state indoor air research programs. ✓

The Business Council on Indoor Air (BCIA) was formed in 1988 to address growing mutual concern of a wide spectrum of industries about the national issue of indoor air quality. This paper represents a consensus among BCIA member firms with industrial hygiene, analytical chemistry, and engineering expertise regarding the most effective program for ensuring good indoor air quality.

Introduction

Indoor air quality concerns emerged as an issue in the 1980s primarily as a result of the energy conservation philosophy that evolved from the energy crisis of the 1970s. While reducing the amount of outdoor air used to ventilate buildings, many new and renovated buildings also were made more airtight to improve energy efficiency. Other exacerbating factors included the proliferation of poorly designed and operated building ventilation systems, overcrowding and alteration of office spaces, and changes in building use without appropriate ventilation modifications.

As a consequence of these trends, concerns have emerged about potential emissions from construction materials, office equipment, pesticide applications, and other sources. In fact, measurable concentrations of substances attributed to these sources have been observed in several studies. These trends also have been found to exacerbate the potential for the proliferation of biological contamination.

In its 1987 report entitled "Policies & Procedures for Control of Indoor Air Quality," the National Research Council (NRC) concluded:

The levels of both chemical and biological contaminants are strongly associated with the cleanliness of the heating, ventilation and air conditioning system.

Moreover, the NRC report noted the complexities associated with identifying the source of indoor air quality problems:

A number of factors are involved in the generation of building-related occupant complaints. Many of these can occur simultaneously. It is rare that a specific source for

the complaints can be identified, and solutions can usually be implemented without such identifications.

The U.S. Environmental Protection Agency (EPA), in the Research Needs section (Volume III) of its recent Report to Congress, further noted that "more can be done to reduce overall exposures and risks by altering building designs and ventilation patterns than by approaching the problem source-by-source or pollutant-by-pollutant."

Adequate Ventilation and Filtration

Two of the most common denominators in buildings with reports of poor indoor air quality are inadequate ventilation and poor filtration. Ventilation problems, in turn, can result from insufficient outdoor air intake and/or poor distribution of that air. Inadequate filtration is frequently a major contributor to the third most common problem: the accumulation of dirt, dusts, and microbes inside the air handling units and their associated ductwork.

The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), a standards-setting group that develops voluntary consensus guidelines for building designers and contractors, has recognized the importance of higher ventilation rates in improving overall indoor air quality. ASHRAE's new ventilation standard (ASHRAE 62-1989, Ventilation for Acceptable Indoor Air Quality) increases the base minimum ventilation rate from 5 cubic feet of air per minute per person (cfm/person) to 15 cfm/person. In developing its new ventilation guideline, ASHRAE recognized that the previously recommended ventilation rate was insufficient to provide adequate indoor air quality in most modern buildings.

For general office space, ASHRAE 62-1989 recommends a minimum rate of 20 cfm/person, assuming a maximum occupancy of seven persons per 1000 square feet. The ASHRAE guideline also prescribes supply rates of outdoor air required for acceptable air quality. In addition, ASHRAE 62-1989 specifies a second method for achieving acceptable indoor air quality (the "Indoor Air Quality Procedure") which provides a contaminant-based approach considering the different kinds of ventilation systems and incorporates both quantitative and subjective evaluations.

There are relatively few sources of indoor air contamination that cannot be at least reduced, if not eliminated, through proper design and management of heating, ventilation, filtration, and air-conditioning systems. In fact, if the prime factor in the design and operation of a building's ventilation system were air quality, rather than the maintenance of a specific temperature, far more emphasis would be given to

minimum outdoor air intake levels, filtration efficiency, and a greater awareness of the hygiene aspects of air handling systems. Such a building-systems approach, including design, operation, and maintenance, is the most important and cost-effective step toward reducing contaminants in indoor air.

Building-Systems Approach

The building-systems approach incorporates the principles of the recently adopted ASHRAE Standard 62-1989 and a number of other ASHRAE Standards and Guidelines as the basis for achieving acceptable indoor air quality. Among these other ASHRAE consensus documents are the following: ASHRAE Standard 55-1981 (for comfort); ASHRAE Standard 52-76 (for filtration); and ASHRAE Guideline 1-1989 (for commissioning).

BCIA believes the necessary technology is already available to achieve acceptable indoor air quality. Based on the collective experience of BCIA members and others, few indoor air quality concerns result when an adequate ventilation rate is maintained in conjunction with clean, well-maintained heating, ventilating and air conditioning (HVAC) systems with efficient filtration equipment.

It is, therefore, unnecessary and counterproductive to develop an entirely new approach or avenue of research. The building-systems approach is a comprehensive, on-going process that commences at the initial building design stage, continues through the construction and commissioning stages, and includes proper operator training and effective building operation and maintenance throughout the life of the building. It requires the use of appropriate design criteria, construction documentation, and the provision and implementation of building systems operation and maintenance procedures to ensure the health and comfort of building occupants.

Within the expected life of the building, reasonable changes in its use and occupancy should be anticipated in the design stage. Consequently, specification of the design intent and performance of all installed building systems in suitable commissioning guidelines should be a critical part of the building design. Development of such a comprehensive statement of the ultimate heating, ventilation, and air conditioning (HVAC) system performance criteria will provide individuals interested in building renovation or modification with the necessary information to provide adequate indoor air quality.

Application of the Building-Systems Approach

The key to addressing potential indoor air quality problems is prevention. With the comfort of employees at stake and the prospects of increased absenteeism and the potential loss of productivity, forward thinking employers are finding it cost effective to ensure that indoor air quality and employee welfare are maintained. The building-systems approach, as described here, is an important management tool that should be applied to both existing and planned buildings to prevent problems rather than attempting to cure them once they happen. BCIA recommends that any regulatory approach to addressing indoor air quality include the following items:

- I. Incorporation of the minimum ventilation rates defined in ASHRAE Standard 62-1989 ("Ventilation for Acceptable Indoor Air Quality") into applicable building codes. These rates will maintain the levels of most, if not all, indoor contaminants below acceptable levels.

These ventilation rates presuppose that the air provided from the outdoors contains acceptable levels of any of the contaminants in question. If the outdoor air exceeds any of these levels, air cleaning systems may be required. If such technology is not available, it may be necessary to reduce the amount of outdoor air during periods of high contaminant levels (e.g., afternoon ozone level peak and rush-hour periods).

- II. Provisions for annual inspections of the air handling equipment of all commercial buildings to ensure cleanliness and proper operation. These inspections should include, at a minimum: (1) internal chambers of each air handling unit, (2) coils and drain pans, (3) internal insulation of the air handling chambers and the main air supply duct, and (4) humidifying equipment. Inspections also should include verification of compliance with proper schedules for filter changes and maintenance and calibration of HVAC controls.

It is critically important that building system performance and air quality be periodically reviewed as part of an ongoing building systems audit process, thereby assuring that the health and comfort of building occupants are both

monitored and maintained throughout the life of the building.

- III. Specifications that air handling systems in commercial buildings contain filters that meet the applicable ASHRAE guidelines. This will assure an efficiency of approximately 15 to 20 percent for the respirable sized particles (generally accepted as under 3.5 microns in size), while minimizing resistance to the airflow for energy conservation purposes.

These filters should be fitted to prevent air by-pass, periodically inspected for fit and condition, and replaced according to manufacturers specifications to provide continuous performance at rated efficiencies.

- IV. Provisions that new building designs include a comprehensive statement of the ultimate HVAC system performance criteria to provide individuals interested in building renovation or modification with the necessary information to assure adequate indoor air quality.

This statement should include the following information: (1) suitable design criteria for all appropriate building systems and components, (2) a complete description of the HVAC system and its intended operation and performance, (3) a commissioning plan including a complete description of the work to be performed during construction, (4) verification procedures for any tests and demonstrations to be performed, and (5) a complete list of documentation submittals required at the completion of commissioning that can be used as educational tools for operator training of building personnel.

A large body of experience from public and private environmental organizations supports the building-systems approach. Extensive field experience in recent years has shown a very high level of success when applying these principles. Application of this approach has already proven itself to be the most economical and effective means of immediately making indoor environments more pleasant places to work. The use of this building-systems approach would eliminate complaints in most reported problem buildings.

Additional Research on the Building-Systems Approach

Indoor air research funds should be directed toward those strategies that are proven, or most likely, to provide practical, effective, and permanent solutions. It is clear that proper design, operation, and maintenance of building systems is the most effective strategy for addressing the widest variety of indoor air quality problems. As such, BCIA recommends that greater emphasis be placed on ventilation, filtration, and building-systems research, and that this research be conducted in cooperation with the private sector.

While much is known about the potential for the building-systems approach to eliminate or mitigate any potential indoor air quality problems, additional research is necessary to refine our understanding of the application of such an approach. Among those areas requiring additional research, BCIA includes the following:

1. Ventilation optimization - Ventilation for indoor air quality not only depends on the quantity and quality of the outside air that is brought into the building, but also on the movement of that air within the building. Research into the distribution of outdoor air through the building may provide insight into the maximum use of outdoor air in maintaining the comfort of all building occupants. It is possible that we could place less reliance on the quantity of outside air necessary to achieve acceptable air quality if more was known about optimal placement of the outside air coming into a building.

Such research could include extensive measurement of the actual outdoor air volumes taken into buildings and investigation of indoor air distribution patterns, as well as the design and placement of supply and return points within individual rooms. The use of sampling systems built into the construction of buildings should also be included in this research area.

2. Filtration - At present, no standards exist for filter efficiency testing that uses particles of a size and type most representative of indoor air environments. Furthermore, continued research should be encouraged in the use of adsorbents and absorbents for removal of gaseous contaminants in both supply and return air.

3. Dry and liquid dessicants - These technologies are emerging as potentially useful tools in indoor air quality control. The potential for their widespread use should be studied.
4. Biological contamination - There is insufficient information about the extent, routes of exposure, and health consequences of microbiological contamination within buildings. Given that great variations occur with regard to the numbers of a particular species of microbes required to trigger infections or allergic reactions, compounded with the variability of individual susceptibility, research is needed to elucidate the role of microbes in the indoor air. It is essential that standard methods of sampling and culturing be established so that the results of independent researchers are comparable. Suggested areas of research include the health effects of bacterial endotoxins and fungal glucans, including evaluations of substances from commonly found species previously discounted as "harmless."
5. Productivity - Research on the effects of poor indoor air quality on productivity should be combined with building-systems research to provide additional incentives for the implementation of recommendations on building systems.

Summary

BCIA recognizes that not all indoor air quality problems can be avoided through improved design, operation, and maintenance of building systems. It is clear, however, that the building-systems approach is the most cost-effective way to address the majority of potential indoor air quality problems. Consequently, the highest priority should be placed on the promotion of responsible building systems design, maintenance, and operation. Steps to identify and control sources of individual pollutants should be undertaken only after it has been determined that the building-systems approach will not adequately address the problem.



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TESTIMONY OF THE BUSINESS COUNCIL ON INDOOR AIR

BEFORE THE SUBCOMMITTEE ON CLEAN AIR AND NUCLEAR REGULATION OF THE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS UNITED STATES SENATE

REGARDING THE INDOOR AIR QUALITY ACT OF 1993 (S. 656)

MAY 25, 1993

Introduction

The Business Council on Indoor Air (BCIA) appreciates the opportunity to present its views on the Indoor Air Quality Act of 1993 (S. 656). BCIA represents a wide spectrum of industries interested in indoor air quality. Our membership is composed of firms with analytical and engineering expertise in monitoring, controlling, and improving the quality of the indoor environment, companies that are owners of and/or tenants in a wide variety of commercial buildings, and manufacturers of chemicals, consumer products, and building materials.

BCIA agrees with the sponsors of this legislation that protecting indoor air quality is of primary importance. BCIA further agrees that federal resources should be directed at identifying indoor air quality problems and at finding the most efficient methods to remedy those problems.

In light of existing federal authorities and programs, BCIA questions the need for indoor air legislation. This is particularly true if the Occupational

Health and Safety Administration (OSHA) proceeds toward a general indoor air quality rulemaking that would ensure proper operation of building systems. We do not oppose legislation, however, that would better clarify and coordinate federal research and other activities directed at cost-effective solutions to indoor air quality problems.

This testimony discusses the general issues relating to a federal indoor air quality strategy and the specific issues raised by the provisions of indoor air legislation that has been introduced in 103rd Congress. In this testimony, we will discuss the overall approach to addressing indoor air quality, the need for additional research on indoor air pollution, and the appropriate nature of any regulatory initiatives and public communications regarding this issue. While the details and examples presented in this testimony relate to commercial office buildings, the principles described herein are generally applicable to residences and other indoor situations as well.

Overview of Building-Systems Approach

Two of the most common factors in buildings with reports of poor indoor air quality are inadequate ventilation and poor filtration. Ventilation problems, in turn, can result from insufficient outdoor air intake and/or poor distribution of that air. Inadequate filtration is frequently a major contributor to the third most common problem: the accumulation of dirt, dust, and microbes inside the air handling units and their associated duct work. A 1988 study by the Walter Reed Army Institute found that the incidence of respiratory infection was 50 percent higher in modern, energy-efficient buildings than in older, less airtight buildings.¹ According to the National Center for Health Statistics, such respiratory ailments accounted for one half of all absenteeism of the U.S. labor force between 1983 and 1985.²

In a 1987 report, the National Research Council (NRC) noted the complexities associated with identifying the source of occupant symptoms and complaints related to indoor air quality problems and concluded that:

¹ Brundage, J. et al., 1988, Building-Associated Risk of Febrile Acute Respiratory Diseases in Army Trainees, *J. Am. Med. Assoc.*, 259(14): 2108-2112.

² National Center for Health Statistics, 1989, Vital and Health Statistics - Health Characteristics by Occupation and Industry: United States, 1983-85, Series 10, No. 170, Page 25.

The levels of both chemical and biological contaminants are strongly associated with the cleanliness of the heating, ventilation and air conditioning system.³

The U.S. Environmental Protection Agency (EPA), in its 1989 Report to Congress, further noted that "more can be done to reduce overall exposures and risks by altering building designs and ventilation patterns than by approaching the problem source-by-source or pollutant-by-pollutant."⁴

BCIA agrees with the conclusions of NRC and EPA, and has strongly supported the development of a "building-systems" approach to addressing potential indoor air quality problems. Such an approach focuses on the design, maintenance, and operation of ventilation, filtration, and other building systems, and encompasses the principles of several of the standards and guidelines developed by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), including ASHRAE Standard 62-1989. Among its provisions, ASHRAE Standard 62-1989 increases the minimum ventilation rate to 20 cubic feet per minute of outside air per person (cfm/person) from the previous recommendation of 5 cfm/person for office space.⁵

The building-systems approach to indoor air quality is not just a matter of increased ventilation, however, but a comprehensive process that promises to improve air quality indoors with a minimum of expense and regulatory effort. In the case of new buildings, this approach commences at the building-design stage, continues through the construction and commissioning stages, and includes proper operator training and effective building operation and maintenance throughout the entire life of the building. For existing buildings, it includes testing, maintenance, and possible redesign of ventilation, filtration, heating, and air conditioning systems.

A large body of experience from public and private organizations supports the building-systems approach. Extensive field experience in recent years has shown a very high level of success when applying these principles. Application of this approach has already proven itself to be the most economical and effective

³ NRC, 1987, Policies and Procedures for Control of Indoor Air Quality.

⁴ EPA, 1989, Report to Congress on Indoor Air Quality, Volume III - Indoor Air Research Needs, Page 3.

⁵ ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality.

means of immediately making indoor environments more pleasant places to work. Because of its potential to address the majority of potential indoor air quality problems in the most cost-effective way, the building-systems approach also should receive high priority in federal indoor air research programs.

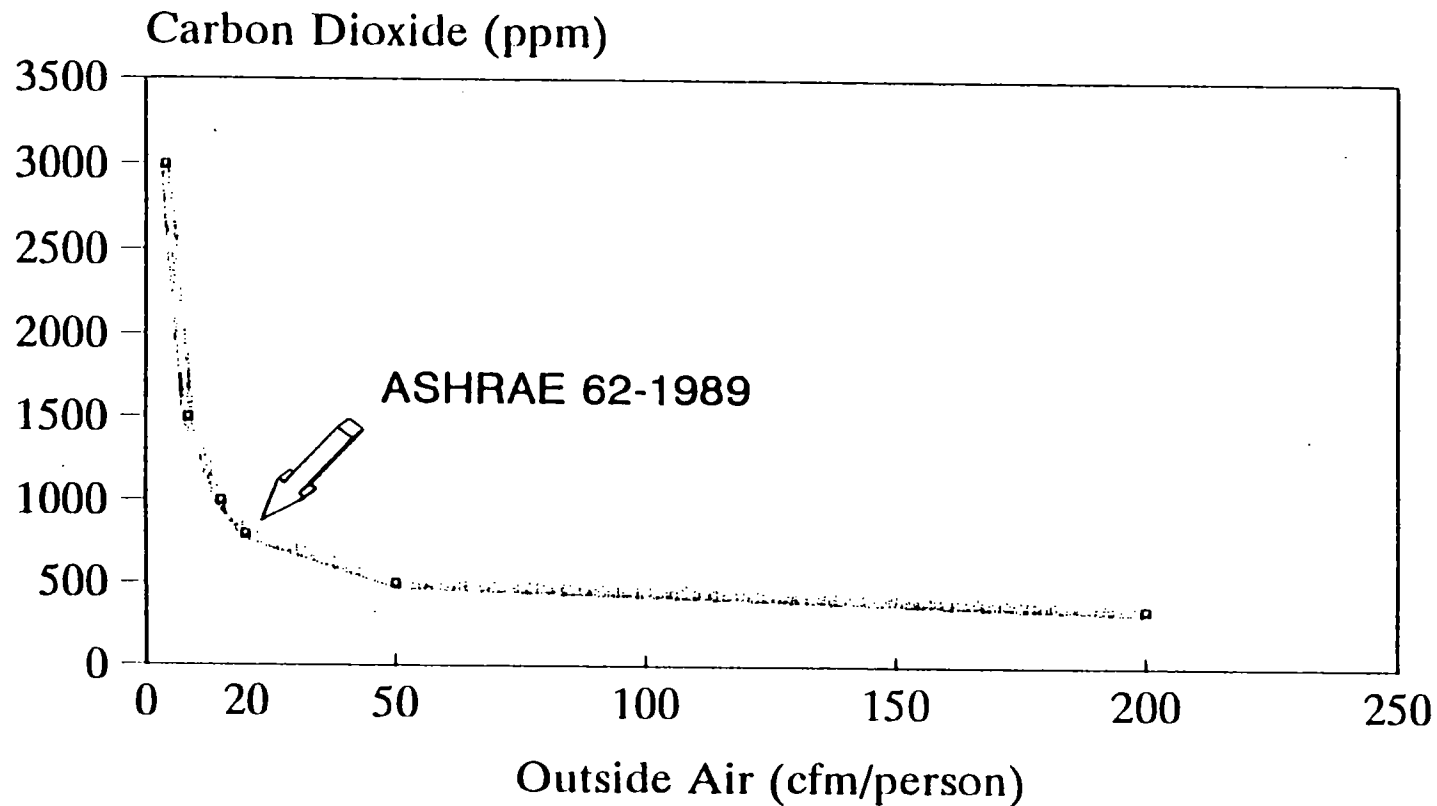
BCIA considers the building-systems approach to be an important management tool that should be applied to both existing and planned buildings. We support the development of a uniform criteria relating to proper design and maintenance of building design and engineering and the benefits of flexibility. We wish to note that such a process already is underway as an increasing number of regional and state building codes have adopted technology guidelines consistent with the ASHRAE Standard.⁶ If a formal, technology-based standard is to be pursued, we believe a well-coordinated, joint effort among the key federal agencies is essential. In fact, we have encouraged OSHA to begin such a program under its existing authority, and it is our understanding that an OSHA rulemaking on indoor air quality may be initiated in the near future.

Importance of Ventilation

The solution to indoor air quality problems often has been characterized, unfortunately, as a choice between increased ventilation and the control of contaminant sources. While it is clear that a variety of measures may be necessary to maintain acceptable air quality in certain circumstances, adequate ventilation must remain a cornerstone of any indoor air quality strategy. The value of ventilation can be seen in **Figure 1**, which plots carbon dioxide (CO₂) concentration versus ventilation rate in a typical office environment. These data were derived from Appendix D of ASHRAE Standard 62-1989, and form the basis of the standards' recommended 20 cfm/person of outside air for general office space. As you will note from **Figure 1**, there is a very rapid drop-off of CO₂ concentration up to a ventilation rate of 20 cfm/person and a much slower decrease in concentration at ventilation rates above 20 cfm/person. The ASHRAE recommendation for minimum ventilation rate in offices, therefore, provides for optimum dilution/removal while minimizing energy costs.

⁶ In most cases, these codes do not encompass the operation and maintenance of building systems, and further efforts to encourage a uniform approach to this issue would be helpful.

FIGURE 1.
Relationship of Carbon Dioxide
to Ventilation



Assumptions: 7 persons/1,000 sq. ft.; outdoor CO₂ = 350 ppm; sedentary office staff.

While CO₂ is not an indoor contaminant of concern, it is sometimes used as a surrogate for other gaseous compounds in indoor environments. The concentration profiles for most volatile organic compounds (VOCs), radon, and many particulate contaminants (including some bacterial pathogens) demonstrate similar response patterns.

Recent data collected by researchers at McGill University, and published in the *New England Journal of Medicine*,⁷ concerning the relationship between ventilation rate and the incidence of symptoms generally attributed to "sick building syndrome," however, has been incorrectly and inappropriately cited as indicating that ventilation is not effective in improving indoor air quality. While the data from this study suggest that increasing the ventilation rate **beyond** those levels recommended in ASHRAE 62-1989 did not reduce occupant complaints, the study did not investigate the far more relevant question -- what are the benefits of increasing ventilation rate from the previous ASHRAE level of 5 cfm/person to 20 cfm/person. As indicated in **Figure 1**, it is in this lower range that one would expect to find occupant complaints.

It is important to note that the buildings investigated in the study were not what would generally be considered sick buildings, and the significance of the study's findings in the context of public policy decision making is highly questionable.

Energy Impacts

Without doubt, the major obstacle to implementation of a building-systems approach is the misperception that the increased ventilation aspects of such an approach will result in a significant increase in energy consumption and costs. While the numbers will vary, depending on where the building is located and on the efficiency of its heating, ventilation, and air conditioning (HVAC) system, the energy costs required to meet ASHRAE 62-1989 generally are not substantial.⁸ In fact, the Bonneville Power Authority has concluded that ASHRAE 62-1989 has a minimal impact on energy use and energy cost regardless of building type or

⁷ Menzies, R. et al, 1993, The Effect of Varying Levels of Outdoor-Air Supply on the Symptoms of Sick Building Syndrome, *N. Eng. J. Medicine* 328(12): 821-827.

⁸ Eto, J.E. and C. Meyer, 1988, The HVAC Costs of Fresh Air Ventilation, *ASHRAE Journal*, September.

location.⁹ Moreover, heat-exchanging technology has been developed, and is commercially available, that can further increase energy efficiency and reduce energy costs.

Source Management

BCIA recognizes that not all indoor air quality problems may be solved through improved design, operation, and maintenance of building systems. In some situations, it may be necessary to manage specific sources in order to ensure adequate indoor air quality. This often can be achieved through proper scheduling of renovation, maintenance, and cleaning activities, air cleaning, and enhanced local ventilation. In the cases of asbestos and lead in paint, however, conventional wisdom now tells us that removal may create a greater health risk than leaving the material in place.

In addressing indoor air quality problems, BCIA strongly recommends a two-phase program that first implements and evaluates the effectiveness of the building-systems approach (including prudent management of sources) before significant resources are devoted to source- or pollutant-specific control measures. If such a program is not pursued, two sources of inefficiency and delay would be created: (1) pollutants that become insignificant with adequate building systems would be regulated unnecessarily, and (2) it would be necessary to develop a risk assessment framework for the evaluation of simultaneous exposures to low levels of multiple indoor air contaminants from multiple sources.

No adequate framework has been developed or validated to reflect actual human risk from low levels of exposure to pollutants in changing indoor environments, and it is very unlikely that one can be developed in the near future. Consequently, BCIA generally does not regard a source-by-source or pollutant-by-pollutant approach to be the most cost-effective method for improving general indoor air quality in the majority of commercial or residential buildings.

⁹ Steele, T. and M. Brown, 1990, Energy and Cost Implications of ASHRAE Standard 62-1989, Report prepared for the Bonneville Power Authority. January 15.

Review of Key Provisions of Senate Indoor Air Quality Proposal

The remainder of BCIA's testimony is devoted to comments on several specific sections of the Senate indoor air legislation.

Section 5 - Indoor Air Quality Research

We fully agree that further research on indoor air quality is needed. We believe, however, that research and mitigation efforts should be prioritized and focused so that the most promising steps to protecting and improving indoor air quality can be identified, evaluated, and implemented.

It is essential that the many public information, research, and mitigation programs now underway, and those planned for the near future, be coordinated to provide the most valuable information for improving indoor air quality in a cost-effective manner. A fundamental step in that coordination effort is the setting of realistic priorities so that the limited federal funds available are used in the most efficient way possible. In our 1989 comments to EPA's Science Advisory Board on research needs for indoor air quality, we urged that the Agency adopt criteria for setting priorities based upon sound scientific principles, and that these criteria be applied in such a way that the projects yielding the most timely and useful information are funded first.

Clearly, the most important and cost-effective step toward preventing, mitigating, or eliminating indoor air quality problems is improvement of building-systems design, operation, and maintenance. Because a source-by-source or pollutant-by-pollutant approach is fraught with inefficiencies and scientific problems and uncertainties, BCIA strongly recommends that research funds should be directed first toward strategies that have been demonstrated to provide practical, effective, and permanent solutions. Improvement of ventilation and filtration is one such strategy.

Building-Systems Research

While much is known about the potential for the building-systems approach to eliminate or mitigate potential indoor air quality problems, additional research is necessary to refine our understanding of the application of these measures. Among those areas requiring additional research, BCIA includes ventilation optimization, filtration, air cleaning, and the relationship between indoor air quality and worker productivity.

In this area, research that can be conducted in cooperation with the private sector should be given high priority. Such research will promote (a) non-adversarial partnerships between government and industry, (b) development of, and access to, highly advanced technology in industry, and (c) credibility in project planning, implementation, analysis, and interpretation.

Healthy Buildings Baseline Study

Monitoring data collected over the past ten years by EPA show concentrations of some contaminants to be considerably higher indoors than outdoors. These studies, such as EPA's Total Exposure Assessment Methodology (TEAM) research program,¹⁰ have not addressed the broad range of indoor air contaminants, however, nor have they incorporated consideration of ventilation conditions and other mechanical systems in the buildings in which the measurements were taken.

Without the knowledge of the ventilation and other building systems at monitoring sites or the health and comfort of occupants, it is difficult to assess the significance of TEAM and other data to evaluate potential remedial actions. It is equally difficult to assess the contribution of particular sources of contaminants without first developing some baseline against which it can be compared.

To establish an acceptable baseline for comparing and assessing indoor monitoring data, BCIA proposes the development of a federal research project to evaluate indoor air quality in buildings that comply with the generally accepted principles incorporated in our building-systems approach. Such a program to be conducted by EPA and the National Institute for Occupational Safety and Health (NIOSH) in cooperation with private industry, would build on the existing research to include the following significant additions: (1) the buildings to be sampled would be selected on the basis of compliance with the building-systems approach, and (2) the list of contaminants to be monitored would be expanded to include biological contaminants, respirable particulates, carbon monoxide (CO) and CO₂. The study also should include an evaluation of the buildings' indoor air quality histories, including the health and comfort of building occupants.

Such a study of indoor environments would provide the much needed baseline data for evaluating indoor air quality. BCIA wishes to note that

¹⁰ Wallace, L.A., 1987, The Total Exposure Assessment Methodology (TEAM) Study: Summary and Analysis, Vol. I, EPA Office of Research and Development, EPA/600/6-87/002a.

provision for such a baseline study is included in indoor air legislation recently introduced in the House (H.R. 1930), and EPA currently plans to begin research similar to that outlined above later this fiscal year.

Biological Contamination

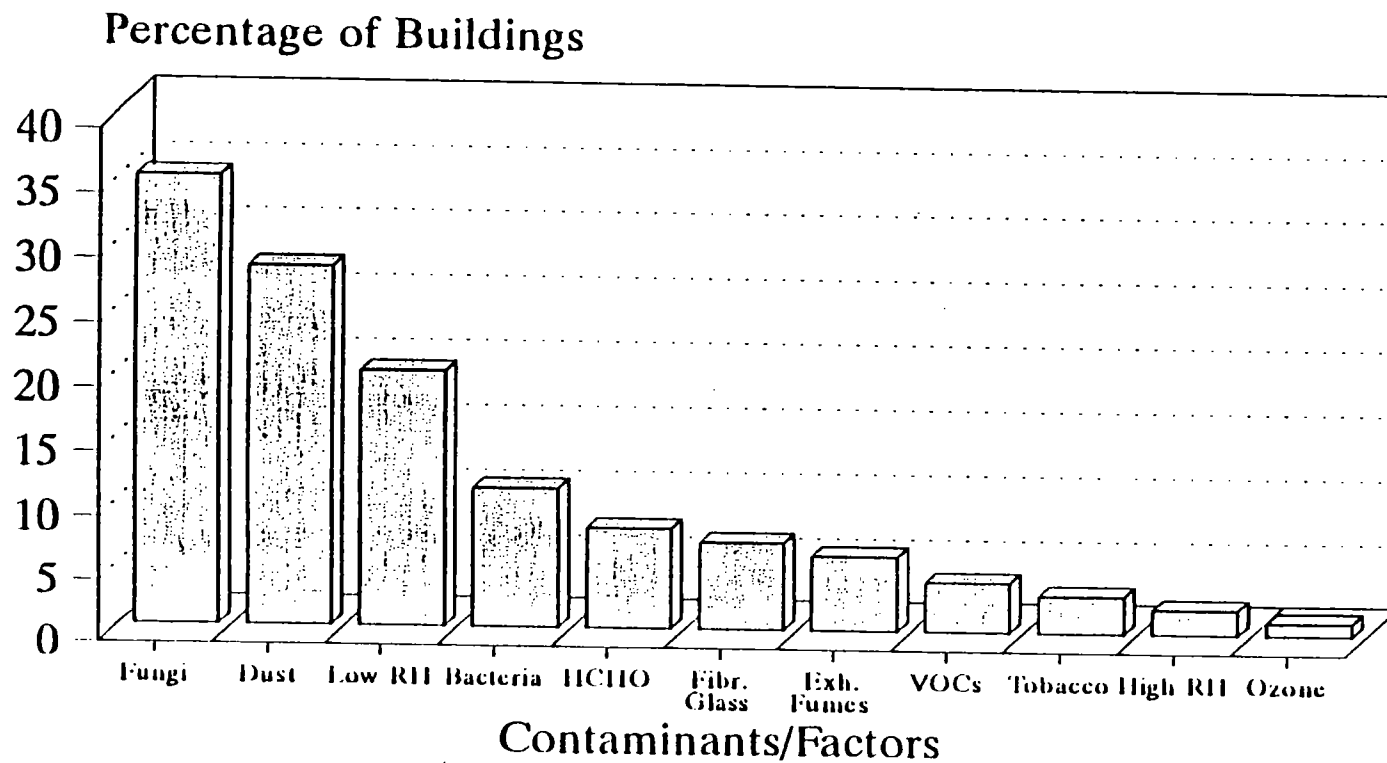
Biological contaminants in industrial and non-industrial environments encompass a wide range of pollutants including bacteria, fungi, viruses, exoskeletons of mites and insects, animal dander, and dead human skin tissue. Microorganisms can survive and grow in numerous indoor environments that provide moisture and nutrients. The effect of biological contaminants on human health is dependent on the type and magnitude of contamination and on individual susceptibility.

There is an abundance of data indicating that microbial contaminants are a major contributor to indoor air problems. Recent information collected by the Consumer Product Safety Commission (CPSC) indicates that 30 to 50 percent of all structures have damp conditions that may encourage the growth of biological pollutants.¹¹ Data from BCIA members and other private firms indicate that biological contamination may be the cause of 40 to 50 percent of the indoor air problems in commercial buildings. One of BCIA's member companies has tabulated its experience in indoor air analysis and mitigation over the past 10 years. **Figure 2** shows the primary contaminants identified in investigations of about 700 commercial buildings worldwide.

Despite its apparent importance, there is insufficient information about the extent, routes of exposure, and health consequences of microbiological contamination within buildings. Given that great variations occur with regard to the numbers of a particular species of microbes required to trigger infections of allergic reactions, compounded with the variability of individual susceptibility, research is needed to elucidate the role of microbes in the indoor air. It also is essential that standard methods of sampling and culturing be established so that the results of independent researchers are comparable.

¹¹ CPSC, 1989, Summaries of Workshop on Biological Pollutants and Asbestos Abatement in the Home

FIGURE 2.
Incidence of
Indoor Air Contaminants



695 buildings, 103 million square feet
Source: HBI, 1980-1990.

Environmental Illness

Environmental illness is a controversial human health phenomenon similar to other ill-defined syndromes which have been described for over 100 years.¹² It has attracted attention from such diverse groups as lawyers, physicians, insurance companies, scientists, and industry. Those who suffer from environmental illness maintain that the condition is an acquired disorder resulting in an aversion to a wide variety of synthetic materials, ingested foods, and drugs, culminating in symptoms that may be multiple and wide ranging.

Because of the controversy surrounding environmental illness, BCIA strongly believes it is premature to develop governmental policy based on the vague and anecdotal information currently available. Accordingly, the initial focus of environmental illness research should be to seek clarification of the medical/physiological/psychological nature of the syndrome.

BCIA wishes to emphasize that all people deserve quality medical care including correct diagnosis and appropriate treatment. The scientific and medical communities' nascent understanding of environmental illness, however, does not allow us to adequately assess proper diagnosis or treatment. It is of paramount importance, therefore, that the issues surrounding environmental illness be resolved and that the significance of environmental exposure, if any, be established.

To address this issue, only research of the soundest scientific design should be supported, employing double-blind, placebo-controlled techniques.

Section 7 - Indoor Air Contaminant Health Advisories

Public communication of information on potential health risks presents a difficult challenge to any federal program. BCIA agrees that it is important to communicate information to persons who are actually at risk from indoor air exposures that may result in adverse health effects. It is equally important, however, that the information portray the potential health risks accurately, and that it be provided in a form that can be readily understood and applied. It also is critical that the public have sufficient context in which to evaluate the information they are given.

¹² Environmental illness is known by at least 20 synonyms, including multiple chemical sensitivity, total allergy syndrome, and twentieth-century disease.

The two indoor air contaminants typically used as examples when discussing public communication are asbestos and radon. While many other contaminants have been addressed by federal information programs, these two have received the most attention. They also may represent opposite ends of the spectrum of public concern. Awareness of the health risks from exposure to asbestos has sometimes approached hysteria, while federal and state agencies have struggled to raise the public's concern about the potential health risks of radon. This difference results from several factors and exemplifies the complexities of communicating risks to the public.

S. 656 contains one major public communications provision involving the development of health advisories. The current language of the Senate proposal would require that, for at least 11 contaminants, EPA issue a health advisory that (1) describes the potential adverse human health effects of exposures to various concentrations, and (2) provides an analysis of the risk posed by the contaminant at the full range of concentration levels. In addition, the legislation would require the development of a national response plan that will result in the reduction of human exposures to indoor air contaminants subject to health advisories and "attainment, to the fullest extent practicable, of indoor air contaminant levels which are protective of human health."

Unlike the requirements of existing statutes listed elsewhere in the bill, this legislation does not hold EPA to the same minimum standard of scientific evidence that must be satisfied before action could be taken under current laws. The legislation provides simply that health advisories be based on "the most current available scientific and related findings or information." Under this rather loose legislative language, it is unclear what standard must be satisfied before a health advisory may be issued in an area of controversial scientific theory.

If a comparison is made between this approach and the standard that governs agency action under existing statutes, it becomes clear that this legislation would conflict with the evidentiary criteria of those statutes.

Health advisories likely will have a significant impact on the public's use of products and services, including those already regulated under specific laws. In fact, a health advisory may have the same effect as a regulatory action under Section 6 of the Toxic Substances Control Act (TSCA) or another regulatory action under another statute. Yet action under existing laws must be supported by specific scientific findings that can be tested in court when necessary. The informational intent of health advisories does not justify a lesser degree of scientific scrutiny.

BCIA also is concerned that a health advisory that describes potential health effects at "various concentrations" of a contaminant likely would convey information about risks that bears no relationship to actual exposure conditions. Such a process will cause unnecessary alarm and concern among consumers who may be exposed to little or no risk. The public may believe that they are being exposed to significant health risks when actual risks may be nonexistent. Issuance of health advisories, therefore, may not result in the dissemination of relevant information about real and significant risks. It may, instead, provide misleading information about risks that are sometimes over-estimated or nonexistent.¹³

The inclusion of specific indoor air standards or action levels will significantly increase the potential for health advisory information to be incorporated into state and local regulation. Regardless of the "advisory" nature of these materials, inclusion of an action level in a federal publication will undoubtedly be interpreted by states as a scientific finding about that level. Inclusion of such levels, regardless of their scientific basis, further lessens the integrity of the advisory and implies a greater degree of certainty in evaluating health risks than generally exists.

Finally, it is important that the legislation not abandon the valuable scientific review process already in place for health advisory documents under other programs. For example, advisory documents issued under the Safe Drinking Water Act are reviewed by EPA's Science Advisory Board. Such review should be applied to indoor air contaminant health advisories.

Section 8 - National Indoor Air Quality Response Plan

While EPA may be the federal agency that has devoted the most resources to indoor air quality, other federal agencies also are engaged in indoor air activities. As a consequence, many jurisdictional issues will arise as we attempt to develop a comprehensive federal indoor air quality program. Earlier versions of indoor air legislation have tended to assign most of the authority for implementing such a program to EPA. Subsequent revisions have recognized roles for OSHA, CPSC, NIOSH, the Department of Energy, and other agencies.

Coordination of federal indoor air activities through the Council for Indoor Air Quality (CIAQ) is essential. While direct interaction among high level

¹³ BCIA has similar concerns with the disclosure provisions of Section 9 of S. 657 (the Indoor Radon Abatement Reauthorization Act of 1993) for radon levels in schools.

representatives of the CIAQ member agencies is important. BCIA believes it would be advantageous to formalize a few working committees of mid-level officials on key issues. These working committees would be chaired by a representative from the most appropriate agency. We wish to offer the following examples of committees that should be considered: research, workplace indoor air quality, and consumer education.

In developing a national response strategy, it is important that each agency be given the lead role in its area of expertise, while coordinating its activities with the other agencies. BCIA does not believe that insufficient funding is an acceptable reason for failure to assign authority to the proper agency.

As noted above, BCIA also is concerned about the proposal in S. 656 to grant authority in the national response plan to reduce exposures to indoor air contaminants to levels that are "protective of human health." While the plan would be based on the use of authority granted under existing statutes, BCIA believes that the use of the phrase "protective of human health" may effectively lower the standard of proof required under these statutes. BCIA recognizes that the Senate proposal is not intended to grant additional regulatory authority, but we are concerned that it may indirectly grant such new authority. Consequently, we would encourage the Subcommittee to add language that explicitly limits the response plan to authority granted under the existing statutes listed in the legislation.

Conclusion

BCIA is convinced that technology-based criteria based on the total building-systems approach outlined in this testimony (including prudent, common-sense management of sources) has the best chance of improving indoor air quality in the near future. Other approaches would lead to high costs for little or no gain. A well-coordinated federal program, aimed at developing uniform guidelines and conducted in cooperation with industry, academia, and state entities, is both promising and achievable.



BUSINESS COUNCIL ON INDOOR AIR

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June 8, 1993

The Honorable Joseph I. Lieberman
Chairman
Senate Subcommittee on Clean Air
and Nuclear Regulation
Room 505
Hart Senate Office Building
Washington, D.C. 20510

Dear Senator Lieberman:

The Business Council on Indoor Air (BCIA) again wishes to express its appreciation to the Subcommittee and its staff for the opportunity to present its views on Senate indoor air quality legislation (S. 656). We were especially honored to be the only business group represented at the May 25 Subcommittee hearing. During its five years of existence, BCIA has endeavored to represent the interests and views of as broad a range of industries as possible. At the hearing, you asked me about BCIA's membership, and I have enclosed a list of our members for your information.

As a supplement to BCIA's written and oral testimony, we would like to provide additional comments in the following areas: (1) health advisories (Section 7 of S. 656), (2) the national response plan (Section 8 of S. 656), (3) product labeling, and (4) an OSHA rulemaking. This letter is directed at questions or issues that arose during the hearing.

Health Advisories

BCIA's primary concerns with the health advisory section of the Senate legislation, as it is currently drafted, relate to the scientific standards to which these health advisories would be held and to the circumstances under which they

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June 8, 1993
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would be developed. To avoid unnecessary public alarm and to prevent unwarranted impacts in the marketplace, all information contained in a health advisory must be subjected to rigorous scientific review.

The current information program conducted by EPA's Indoor Air Division attempts to avoid a lengthy scientific review process by focusing on practical solutions to potential indoor contaminant problems rather than on controversial health effects data. Passage of the health advisory section, as drafted, would replace EPA's successful and well received public information program with one that would rapidly become mired in scientific debate and, potentially, in litigation.

During the May 25 hearing, Dr. Thomas Godar suggested that one should not expect a significant public response to health advisories, based on the experience with radon. As outlined in our written testimony, BCIA strongly disagrees with the contention that radon can be used as a barometer for the public's response to information on indoor contaminants and that the advisories would have little impact. One need only look at our experience with asbestos to be reasonably convinced that public hysteria often can be the result of such information. Moreover, the inclusion of quantitative risk information in the advisories would virtually guarantee that more important information on proper use would receive little, if any, attention from the general public or the media.

BCIA's experience has been that state and local governments, which are invariably understaffed and often eager to press ahead with regulatory initiatives, will use any quantitative information provided by the federal government as a basis for such initiatives. This state and local activity is certain to occur, regardless of the degree of confidence in the federal government's conclusions and regardless of attempts by federal agencies to explain the uncertainties.

If the health advisories are not expected to have an impact on consumer use patterns, there seems to be little reason to produce them. If, on the other hand, the advisories are expected to have an impact in the marketplace, then there is every reason to impose a high scientific standard for their content. As I mentioned at the hearing, there is currently no minimum scientific, evidentiary standard that must be met before a health advisory may be issued. You correctly pointed out that health advisories will be subject to peer review. In the absence of a minimum standard against which a health advisory can be "peer reviewed," however, review will provide scant assurance of the scientific validity of the contents.

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All of the laws under which action may be taken as part of the response plan require a minimum threshold level of concern before regulatory action can be taken. Although health advisories are not intended to be regulatory, they will undoubtedly have an impact in the marketplace that might be as great as any regulatory action. It is inappropriate, in our view, that the threshold for action may be lowered under S.656 simply by taking action through a health advisory, rather than pursuant to the various statutes referenced in Section 8.

Response Plan

BCIA wishes to emphasize those points made by the Administration in the written testimony submitted by EPA regarding the need to recognize each agency's statutory requirements relating to IAQ issues. We are concerned that, by attempting to establish EPA as the lead agency in the development of a national response plan, the legislation would hinder other agencies' efforts to comply with their own statutory mandates. To prevent such confusion, BCIA has suggested an alternative system that would establish the most appropriate agency as the lead for each of the key elements of a national program and would coordinate these activities through the interagency Council on Indoor Air Quality (CIAQ).

BCIA also wishes to reiterate its concerns with the specification in Section 8 that levels of indoor contaminants be reduced to levels that are "protective of human health." Such language appears to establish a different, lower standard by which EPA and other agencies may use existing statutory authority to regulate indoor contaminants. This runs directly contrary to the non-regulatory intent of this section.

Product Labeling

BCIA believes that additional product labeling authority is not necessary. EPA, CPSC, and OSHA currently require product labeling under the authorities of the Toxic Substances Control Act (TSCA), the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Federal Hazardous Substances Act (FHSA), and the Occupational Safety and Health Act, respectively. Moreover, we have several specific concerns with the proposed labeling requirements that have been suggested previously by certain organizations. Specifically, we question the utility of emission-rate data and the advisability of a consumer education program to emphasize the selection of products with lower emission rates.

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BCIA does not believe that emission-rate data for indoor air contaminants will provide the public with information that it can use effectively to reduce exposures to contaminants of concern. More importantly, reduction in emission rates may not result in exposure reduction or safer products. For solvent-containing products, exposure will depend to a large extent on how the product is used, rather than on the specific formulation. BCIA believes, therefore, that instructions for safe use are far more valuable than emission-rate values. In fact, existing labeling requirements under both FHSA and FIFRA specify that directions for proper use be included on the label.

For these reasons, BCIA also is concerned that the development of a consumer education program to persuade the public of the benefits of low-emission products will pay insufficient attention to product safety and efficacy. The vast majority of the substances to which people are exposed indoors do not pose a health threat at the low levels generally encountered. Even in cases where emission-rate data can provide some basis for comparison between competing products, such data alone do not provide a context in which to evaluate indoor exposures resulting from the product relative to use conditions and other potential indoor exposures.

In addition, BCIA is concerned that the proposed legislation suggests that a significant health threat arises from emissions. It is unclear whether the labeling would be based on emissions of the total number of contaminants (volatile organic compounds, combustion products, etc.), on the assumption that all contaminants pose a significant health threat, on a short list of specific contaminants, or on a large number of contaminants. BCIA has concerns about the effectiveness of all of these options.

Combining the emission rates of all contaminants into one value does not distinguish among the different potential health effects of the various contaminants. Moreover, a total contaminant approach would tie the hands of a product formulator in evaluating alternative substances. Specifying a long list of substances subject to emission-rate labeling requirements similarly does not provide any basis for relative comparisons, and would dilute the effectiveness of the labeling. Alternatively, specifying a short list of contaminants would imply that products not emitting these few contaminants are "safe." It would be counterproductive to create a program that would lead to replacement of certain volatile compounds with less volatile but less well studied, and potentially more toxic, substances.

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OSHA Rulemaking

Indoor air may be one of the few issues in which labor, consumer, and health groups, as well as a large segment of the business community, agree on the fundamental basis for a national program: a workplace indoor air quality (IAQ) regulation. BCIA has urged OSHA to develop a general IAQ standard.

The Occupational Safety and Health Act of 1970 requires OSHA to set mandatory safety and health standards that require practices reasonably necessary or appropriate to provide safe or healthful employment or places of employment (29 U.S.C. Section 652(8)). Where inadequate ventilation causes a significant risk of material health impairment and the solution is technically and economically feasible, OSHA clearly has authority to adopt a health standard to improve ventilation. Similarly, where a specific substance emitted in the indoor workplace causes a significant risk, OSHA is authorized to adopt a health standard.

OSHA has already regulated extensively in this regard. In addition to substance-specific standards, the OSHA Hazard Communication Standard requires label warnings and other programs to alert employees to the hazards of substances they handle. Moreover, OSHA began a proceeding to evaluate IAQ problems and the adequacy of existing regulations in September 1991 and BCIA has urged OSHA to use its authority to address building-systems problems in the workplace.

The requirements of the 1970 Act do not differentiate between industrial and non-industrial workplaces. BCIA believes, therefore, that OSHA has adequate authority to promulgate a safety and health standard and/or guideline that applies the building-systems approach to solving or preventing IAQ problems in most workplaces.

We believe that most IAQ problems can be addressed as part of an OSHA rulemaking. While we are unconvinced that indoor air legislation is necessary at this time, if such legislation is to move forward it makes little sense to omit the one element that would have the greatest impact on IAQ: a directive to OSHA to issue a general indoor air rulemaking that would require proper design, operation, and maintenance of building systems.

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Filtration

The question of filtration efficiency was raised at the May 25 hearing by another witness. In Table 2 (page 5) of the enclosed article ("Filtration Selection on an Engineering Basis"), HEPA filters are shown to trap 99.97% of all particles 0.3 microns or larger. When this filter is combined with zeolite to trap VOCs, we have an extraordinarily effective filtration unit.

* * * * *

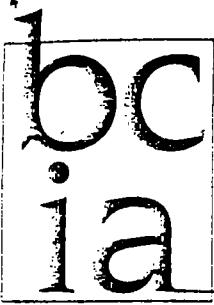
I hope that these comments are useful to the Subcommittee as it considers indoor air legislation, and we look forward to discussing them with you at your earliest convenience.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Paul Cammer', with a long horizontal flourish extending to the right.

Paul A. Cammer, Ph.D.
President

Enclosures



BUSINESS COUNCIL ON INDOOR AIR

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BEFORE THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

Response of the
Business Council on Indoor Air
to the

Request for Information
Concerning
Occupational Exposure to Indoor Air Pollutants

56 *Federal Register* 47892
(September 20, 1991)

Docket No. H-122

Paul A. Cammer
President

BUSINESS COUNCIL ON INDOOR AIR
RESPONSE TO THE
REQUEST FOR INFORMATION CONCERNING
OCCUPATIONAL EXPOSURE TO INDOOR AIR POLLUTANTS

I. INTRODUCTION

The Business Council on Indoor Air (BCIA) appreciates the opportunity to provide information on occupational exposure to indoor air contaminants, and commends the Agency on its decision to investigate the many complex issues relating to indoor air quality (IAQ). BCIA is an association of companies with strong, but varied, interest in the indoor air issue. Among its members BCIA includes architects, building engineering firms, clean room specialists, IAQ monitoring and mitigation firms, and manufacturers of building products, consumer products, chemicals and raw materials, and office products.

Since its inception in 1988, BCIA has advocated the implementation of a building-systems approach as the most promising method for ensuring adequate IAQ in a reasonable period of time. This approach encompasses the proper design, operation, and maintenance of heating, ventilation, and air conditioning (HVAC) systems and is described in greater detail below and in Attachment 1.

To aid in its review, BCIA's comment is divided into four sections. Section II addresses the final question in the Request for Information regarding the potential content of an OSHA indoor air regulation. Section III of the comment discusses the legal framework in which an OSHA indoor air standard can be promulgated. Section IV summarizes some of the evidentiary support that exists for implementation of such a standard.

Finally, Section V includes responses to many of the specific questions raised in the Request for Information. For those questions addressing a company's individual policies, practices, and experiences, BCIA has summarized the experiences of its members engaged in IAQ investigation activities. Since BCIA concentrates on generic rather than industry-specific IAQ issues, we have not provided answers to those questions concerning specific contaminants.

II. POTENTIAL CONTENT OF REGULATION

BCIA considers the building-systems approach to be an important management tool that should be applied to both existing and planned buildings. BCIA recommends that future approaches to IAQ regulation include provisions for optimal air exchange and filtration and proper management of building systems. Specifically, BCIA recommends that a technology-based approach to addressing indoor air quality in commercial buildings be adopted including the following items:

- o minimum ventilation rates or other means of achieving acceptable indoor air quality as defined in ASHRAE Standard 62-1989,
- o annual inspections of the air handling equipment to confirm correct operating procedures and to ensure adequate standards of cleanliness,
- o use and maintenance of filters and other air cleaning devices that meet applicable ASHRAE guidelines,
- o a comprehensive statement of the heating, ventilation and air conditioning (HVAC) system performance criteria, and
- o commissioning of buildings, consistent with ASHRAE Guideline 1-1989, to ensure performance to specifications.

To date, the most frequently proposed regulatory approach to improving indoor air quality through ventilation and building-systems management has been the adoption of federal performance standards. In our view, a comprehensive building-systems approach should certainly include, but not be limited to, specific performance guidelines for ventilation. As is often the case, however, the development of general, average guidelines or specifications may not adequately address the complexities and variations in commercial building environments. Available data indicate considerable potential for wide variations in ventilation rate between summer and winter and between the zones of the building. These data demonstrate the complexities associated with providing adequate ventilation, even in a well-designed building, and the limitations of using average values.

There is much more to the building-systems approach is a more reasonable method of ensuring , however, than ventilation rates. Proper maintenance of these systems is crucial to ensuring good indoor air. Adequate training also is an integral part of proper building-systems maintenance. We suspect that indoor air quality is not currently a major part of the various curricula offered for stationary (i.e., building) engineers. A certification program for these engineers might be one method for augmenting their training and awareness in this area. We also believe that indoor air quality should play a stronger role in the design of new and remodeled buildings. One way this can be accomplished is through modification of building codes.

Taken in its entirety, the building-systems approach is a superior method for ensuring IAQ within a reasonable period of time. It will avoid the extensive delays and costs that have been associated with contaminant-by-contaminant regulation.

First, the building-systems approach remedies a broad array of indoor air quality problems by increasing outdoor air supply, improving its distribution within the building, and decreasing exposure to indoor air contaminants. Moreover, this approach provides a practical solution for indoor air quality problems without the need for identification and control of myriad individual contaminants found in a wide variety of concentrations and mixtures. Because such a large number of contaminants may be present in indoor air, the most cost-effective strategy is one that directs resources toward controlling the broadest array of indoor contaminants.

Second, the benefits provided by the building-systems approach remain intact as the mix of contaminants changes over time. Thus, if building use or interior furnishings change (thereby changing the degree and nature of the potential indoor air quality problem), the approach remains effective. Source controls designed to protect against exposure to a particular contaminant may be rendered obsolete when the contaminant mix changes.

A large body of experience from public and private organizations supports the building-systems approach. Extensive field experience in recent years has shown a very high level of success when applying these principles. Application of this approach has already proven itself to be the most economical and effective means of immediately making indoor environments more pleasant and healthful places to work.

BCIA supports the development of uniform criteria relating to ventilation and other building systems that addresses certain compliance limitations of older buildings. While an increasing

number of states are adopting technology guidelines such as the ASHRAE standard, these guidelines generally do not encompass the operation and maintenance of building systems. Further efforts to encourage a uniform approach to this issue are necessary.

Such an indoor air standard would be generally applicable to all employers, including many small businesses in older buildings. All building operators can implement at least some aspects of such a building-systems approach, although some may not be able to comply with all of its requirements, particularly the ventilation rate specifications. Consequently, any regulation must be sufficiently flexible to accommodate methods of alternative compliance. In addition, OSHA could consider an exemption or "grandfather" provision in the standard for a limited set of buildings on feasibility grounds. OSHA has used such provisions in the past to exempt employers from certain provision of a standard, such as OSHA's electrical standards¹ and OSHA standards governing marine terminals.²

¹ 29 C.F.R. Section 1910.302(b).

² 29 C.F.R. Part 1917; 48 Federal Register 30885, 30887 (July 5, 1983).

III. LEGAL FRAMEWORK FOR PROMULGATION OF AN INDOOR AIR STANDARD

There is substantial support for the conclusion that OSHA has the authority to promulgate a generic indoor air standard. Although OSHA has traditionally regulated workplace air quality by promulgating substance-specific standards, a mounting body of evidence demonstrates that poor indoor air quality poses a substantial risk of material health impairment and that a standard that incorporates the elements of a building-systems approach is reasonably necessary or appropriate to reduce or eliminate that risk.

In view of the many studies that demonstrate the health benefits of adequate ventilation and the health risks associated with poorly maintained ventilation systems and inadequate ventilation, it is not necessary that OSHA first identify individual contaminants, assess chemical-specific and mixture-specific risks and promulgate separate exposure standards for each identified risk. Indeed, such an approach is likely to be so difficult as to be impractical. Instead, OSHA has the legal authority to promulgate a generic ventilation standard pursuant to Section 6(b)(5) of the Occupational Safety and Health Act (the Act).¹

A. General Structure of the Act

The stated purpose of the Act is to "assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources."² To this end, the Act authorizes the Secretary of Labor (the "Secretary") "to set mandatory occupational safety and health standards applicable to businesses affecting interstate commerce."³ The Act does not limit that authority to industrial workplaces, but includes the non-industrial workplace as well.

The Act contains three basic provisions which prescribe the types of standards the Secretary can promulgate. First, Section 3(8) defines an "occupational safety and health standard" to be:

¹ 29 U.S.C. Section 655(b)(5), et seq.

² 29 U.S.C. Section 651(b).

³ 29 U.S.C. Section 651(b)(1).

a standard which requires conditions, or the adoption or use of one or more practices, means, methods, operations, or processes, reasonably necessary or appropriate to provide safe or healthful employment and places of employment.⁴

Second, Section 6(b)(7) specifies that standards "where appropriate" should prescribe "control or technological procedures" to be used in connection with the hazard and

Where appropriate, . . . shall also prescribe suitable protective equipment and control or technological procedures to be used in connection with such hazards and shall provide for monitoring or measuring employee exposure ⁵

Under this general provision the basic statutory delegation of authority to the Secretary to promulgate occupational safety and health standards is very broad. As the D.C. Circuit has stated: "A number of terms of the statute give OSHA virtually unlimited discretion to devise means to achieve the congressionally mandated goal."⁶ Further, the Act itself encourages OSHA to ensure worker safety "by developing innovative methods, techniques, and approaches for dealing with occupational safety and health problems."⁷

The third provision that could be applicable is Section 6(b)(5) of the Act applying to "standards dealing with toxic materials or harmful physical agents," which provides:

The Secretary, in promulgating standards dealing with toxic materials or harmful

⁴ 29 U.S.C. Section 652(8) (emphasis added).

⁵ 29 U.S.C. Section 655(b)(7) (emphasis added).

⁶ United Steelworkers of America, AFL-CIO v. Marshall, 647 F.2d 1189, 1230 (D.C. Cir. 1980), cert. denied, 453 U.S. 913 (1981).

⁷ 29 U.S.C. Section 651(b)(5); see also United Steelworkers, 647 F.2d at 1230.

physical agents under this subsection, shall set the standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure to the hazard dealt with by such standard for the period of his working life. Development of standards under this subsection shall be based upon research, demonstrations, experiments, and such other information as may be appropriate. In addition to the attainment of the highest degree of health and safety protection for the employee, other considerations shall be the latest available scientific data in the field, the feasibility of the standards, and experience gained under this and other health and safety laws. Whenever practicable, the standard promulgated shall be expressed in terms of objective criteria and of the performance desired.⁸

The basic authority contained in these provisions has been interpreted by the courts as authorizing a broad range of requirements to achieve the purposes of the Act and would appear to encompass the sort of requirements that an indoor air standard would impose.

B. Authority to Promulgate a Non-Substance Specific Standard

Although OSHA's traditional approach to health standards is substance-by-substance, there is clear precedent for a generic standard to remedy a complex, multi-factorial health problem. The Hazard Communication Standard (HCS), which requires employers to assess the hazards of chemicals used in the workplace and to provide information to their employees about such hazards, is just such a generic standard.⁹

It has been held that, for OSHA action to be considered a standard, it must be "a remedial measure addressed to a specific

⁸ 29 U.S.C. Section 655(b)(5).

⁹ 48 Federal Register 53280 (November 25, 1983).

and already identified hazard."¹⁰ The court reviewing the HCS found that it was aimed at eliminating a specific hazard -- "the specific hazard that employees handling hazardous substances will be more likely to suffer impairment to their health if they are ignorant of the contents of those substances."¹¹ Inadequate communication was found to be the hazard that the HCS would eliminate or mitigate.

In a subsequent review of the HCS, the Third Circuit dismissed the suggestion that OSHA must first assess the risk to workers and the need for disclosure with respect to each substance in each industry. Such a requirement "would effectively cripple OSHA's performance of the duty imposed on it by 29 U.S.C. Section 655(b)(5): a duty to protect all employees, to the maximum extent feasible."¹² The Third Circuit upheld OSHA's general finding that inadequate communication posed a hazard that the HCS was designed to reduce.

The courts thus would appear to support an OSHA position that the law does not require that OSHA identify the individual components of poorly ventilated air or specific mixtures of such components that might cause the adverse effects noted. The time required to identify what may be hundreds of substances and to assess risks from each under various ventilation scenarios would cause severe delays. Just as the law did not require that OSHA identify and quantify the various risks posed by chemicals subject to the HCS, by the same token the law does not require that individual risks be identified and quantified for all possible contaminants or mixtures that contribute to the effects of poorly ventilated indoor air. Further, this might properly be viewed as an OSHA policy decision, which would be subject to deferential review in court.

Having established that OSHA can promulgate an indoor air standard without making "significant risk" findings for individual substances, the next basic question for OSHA is whether sufficient evidence exists to support a finding that inadequate ventilation itself poses a significant risk of

¹⁰ Louisiana Chemical Association v. Bingham, 657 F.2d 777 (5th Cir. 1981).

¹¹ United Steelworkers of America v. Auchter, 763 F.2d 278 (3rd Cir. 1985).

¹² Associated Builders and Contractors, Inc. v. Brock, 862 F.2d at 63, 68 (3rd Circuit 1988).

material health impairment. Section IV below identifies a number of studies which might be used to support such a finding. The legal principles described in the cases cited above would appear to support a determination by OSHA that such a risk exists.

Because OSHA's determination "that a particular level of risk is 'significant' will be based largely on policy consideration,"¹³ courts have applied the "substantial evidence" test to this determination with varying degrees of deference. In the context of policy decisions, the "substantial evidence" test normally requires OSHA:

to identify relevant factual evidence, to explain the logic and policies underlying any legislative choice, to state candidly any assumptions, contrary evidence and argument.¹⁴

However, courts have made it clear that "OSHA is not required to support its finding that a significant risk exists with anything approaching scientific certainty. . . ." As several reviewing courts have held, this provision requires a court to give OSHA some leeway where its findings must be made on the frontiers of scientific knowledge.¹⁵ In this situation, "OSHA need not await the 'Godot of scientific certainty' while allowing workers to suffer."¹⁶

Some courts have interpreted the "substantial evidence" standard in the context of policy decisions involving scientific uncertainty to require only that OSHA's decision be based on such relevant evidence as a reasonable mind might accept as adequate.

¹³ Industrial Union v. American Petroleum, 448 U.S. 2871 n.62 (1980).

¹⁴ United Steel Workers v. Marshall, 647 F.2d 1189, 1206-97 (D.C. Cir. 1986).

¹⁵ Industrial Union at 2871; see also Public Health Research Group v. Tyson, 796 F.2d 1486 (D.C. Cir. 1986) and National Grain and Feed Association v. OSHA, 858 F.2d 1031 (5th Cir. 1988).

¹⁶ National Grain, at 1039-40, quoting United Steelworkers Steelworkers of America, AFL-CIO v. Marshall, 647 F.2d 1189, 1266 (D.C. Cir. 1980).

to support a conclusion,¹⁷ and that "even if a reasonable person could also draw the opposite conclusion, we must uphold the agency's findings."¹⁸ Further, in the same context, some courts have ruled that "the agency's findings must only be within a zone of reasonableness."¹⁹

OSHA should consider the health effects of inadequate ventilation in this context. Section IV below summarizes a number of studies of the effects of a lack of outdoor air and of poorly maintained mechanical ventilation or air conditioning systems. While not a thorough literature review, the studies provide considerable support for a significant risk finding. Under the legal standard outlined above, such a finding would appear to have substantial support.

¹⁷ Tyson at 1485, quoting Universal Camera Corp. v. NLRB, 340 U.S. 474, 477 (1951), quoting Consolidated Edison Co. v. NLRB, 305 U.S. 197, 229 (1938).

¹⁸ Tyson at 1489.

¹⁹ Forging Industry Association v. Secretary of Labor, 773 F.2d 1436, 1443 (4th Cir. 1985), citing United Steelworkers of America, AFL-CIO v. Marshall, 647 F.2d 1189, 1207 (D.C. Cir. 1980).

IV. EVIDENTIARY SUPPORT FOR AN INDOOR AIR STANDARD

A significant body of evidence exists to support the finding that the improper design, operation, and maintenance of ventilation and other building systems can result in a significant risk to material health impairment. While not an exhaustive list of the available research, the findings of several published studies are summarized below and are included as Attachment 2.

These studies include comparisons of naturally and mechanically ventilated structures, as well as comparisons of buildings with different types of mechanical ventilation. Several studies also review the evidence for cases of building-related illness that have been traced, in some cases, to particular types of biological contaminants. In other studies, where no causative agent(s) could be identified, the incidence of health complaints was found to decrease after improvements to the mechanical systems of the buildings were performed.

Arnow, P.M., J.N. Fink, D.P. Schlueter, J.J. Barboriak, G. Mallison, S.I. Said, S. Martin, G.F Unger, G.T. Scanlon, and V.P. Kurup, 1974, Early Detection of Hypersensitivity Pneumonitis in Office Workers, Amer. J. Medicine 64: 236-242.

The occurrence of hypersensitivity pneumonitis in six employees in an office building was traced to an open-spray air cooling system. Five of the six subjects worked in offices cooled by the spray water system, and the affected workers improved after removal from the work area. The condition improved after the spray units were cleaned with detergents and disinfectants and changes were made to the air flow in the ventilation system, and disappeared after use of the spray water system was discontinued. The authors note that cases of hypersensitivity pneumonitis generally result from frequent occupational or avocational exposure to organic dusts or to aerosols from forced-air heating or cooling systems contaminated with microorganisms. They note that the high attack rates (3-16 percent of exposed subjects), coupled with the diversity of sensitizing antigens and their widespread distribution in the environment, suggest that hypersensitivity pneumonitis may be a frequent cause of recurrent respiratory disease.

The study also indicates that measurement of pulmonary function before and after exposure to the suspected sensitizing environment may be a useful test for hypersensitivity pneumonitis.

Bergland, B. and T. Lindvall, 1986, Sensory Reactions to Sick Buildings, Environ. Intl. 12: 147-158.

The authors examined the available data on the phenomenon of sick building syndrome in a sensory-pollutant context. They note that sick buildings are a physical environment problem and that, while sensations dominate reactions to sick buildings, the perceptual mechanisms are largely unknown. They further point out that the sensory reactions are generally nonspecific, and that the resulting perceptions largely multisensory in origin. They conclude that since indoor air of modern buildings contains a complex pattern of pollutants, one cannot expect to find simple causal relationships between symptoms of sick building syndrome and specific stimuli.

The authors attempt to understand sick building syndrome assuming that the sensory systems perform a pattern-recognition analysis. As a result they speculate the following possible causes of sick building syndrome: (1) extreme multisensory adaptation to the inhaled air; (2) increased sensitivity (from psychosocial stress, allergies, or other stimuli) in the populations exposed; or (3) the summation or interaction of numerous sub-threshold sensory stimuli involving many sensory systems.

Brundage, J.F., R.M. Scott, W.M. Lednar, D.W. Smith, and R.N. Miller, 1988, Building-Associated Risk of Febrile Acute Respiratory Diseases in Army Trainees, J. Amer. Medical Assn. 259(14): 2108-2112.

The authors compared the incidence rates of febrile acute respiratory disease between subjects in modern (mechanically ventilated) and old (naturally ventilated) barracks at four Army training centers during a 47-month period. They found the rates of disease were significantly higher among trainees in modern barracks, and concluded that "tight buildings with closed ventilation systems significantly increase risks of respiratory-transmitted infection."

While the incidence of acute respiratory disease diminished in modern barracks after comprehensive immunoprophylaxis, the authors note that immunization programs are unlikely to control airborne-transmitted infected risks in non-military populations. The authors conclude that building-design characteristics may be modifiable factors of significant attributable mortality and morbidity risk on a nationwide scale.

Brunekreff, B., D.W. Dockery, F.E. Spitzer, J.H. Ware, J.D. Spengler, and B.G. Ferris, 1989, Home Dampness and Respiratory Morbidity in Children, Amer. Review of Resp. Disease 140: 1363-1367.

In a study of over 4,000 children living in six U.S. cities, the authors found a strong and consistent association between measures of home dampness and both respiratory symptoms and other non-chest illness. The authors note that dampness is a potential risk factor for respiratory illness in part through the action of microorganisms (e.g. dust mites, molds) that thrive in damp environments.

Burge, H.A., 1987, Approaches to the Control of Indoor Microbial Contamination, in Proceedings of the ASHRAE Practical Control of Indoor Air Problems Conference (IAQ 87), May 18-20, Arlington, Virginia, p. 33-37.

The author reviews the sources of indoor microbial contamination and the approaches to controlling such contamination. She concludes that indoor microbial pollution occurs (1) when outdoor aerosols penetrate interior situations, (2) when building components become contaminated with microorganisms, or (3) when human and/or animal source microorganisms accumulate in inadequately ventilated interiors.

The author notes that in mechanically ventilated buildings, even 35% efficient filtration will remove a large percentage of outdoor bioaerosol particulate components, and that good quality bag filters can remove more than 90% of outdoor airborne fungus spores. While symptoms resulting from indoor penetration of outdoor aerosols are primarily allergic in nature, the author notes that several human pathogens (i.e., Aspergillus, Legionella, Histoplasma) can penetrate indoor environments.

Water is always involved in the biological contamination of a building's structure. The best measure for prevention of building structural contamination is to keep all surfaces dry. While the design of many ventilation systems require water, produce water as a result of operation, or provide high humidity levels in ductwork, the author argues that "a properly functioning ventilation system will remove both internally and externally produced aerosols."

Symptoms reported as a result of exposure to ventilation system contamination include hypersensitivity pneumonitis, humidifier fever, allergic asthma, allergic rhinitis, and allergic dermatitis. The article presents data on the accumulation of thermophilic actinomycete aerosol within a

building during shut down of air-handling units, and the subsequent decrease to steady state following three days of operation of the units.

The author concludes that the four best methods for prevention of indoor microbial aerosol contamination are: (1) high-quality filtration to prevent penetration of outdoor aerosols; (2) maintenance of low relative humidity, dry surfaces in ventilation systems and prevention of flooding; (3) provision of adequate air to dilute internally produced aerosols; and (4) good housekeeping to eliminate soil which provides nutrients.

Dales, R., H. Zwanenberg, and R. Burett, 1990, The Canadian Air Quality Health Survey: Influence of Home Dampness and Molds on Respiratory Health, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. I, p. 145-147.

The study found that home dampness and mold was associated with increased respiratory symptoms among both adults and children. The association persisted despite adjustment for other influencing variables and were consistent with studies from other countries. The authors report the prevalence of dampness and molds in Canadian homes is about 38 percent, and conclude that it is an important public health issue. They attribute the problems associated with dampness and molds to increased insulation and the reduction of fresh air exchange.

Dennis, P.J.L., 1990, An Unnecessary Risk: Legionnaire's Disease, in P.R. Morey, J.C. Feely and J.A. Otten (eds.), Biological Contaminants in Indoor Environments, ASTM STP 1071, p. 84-95.

The author reviews the occurrence of Legionella pneumophila in man-made water systems, and outlines a maintenance program to significantly reduce the risk of infection and to allow more efficient operation. The program includes: regular cleaning and servicing of water systems; maintaining hot water above 50°C; maintaining cold water below 20°C; maintaining required levels of biocide in cooling towers; chemical and microbiological monitoring; and maintaining a log of monitoring and maintenance records.

Farant, J.P., S. Bedard, R.T. Tamblyn, R.I. Menzies, R.M. Tamblyn, and J. Hanley, 1990, Effect of Changes in the Operation of a Building's Ventilation Systems on Environmental Conditions at Individual Workstations in an Office Complex, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. I, p. 581-585.

An investigation of ventilation systems in three office buildings showed that the concentration of gaseous contaminants (e.g., CO₂, NO_x, TVOC) are related to the amount of outdoor air supplied to the occupied spaces. The authors concluded that, in aged buildings with constant populations and no unusual work activities, the concentration of gaseous contaminants can be maintained at acceptable levels by ensuring that an adequate amount of outdoor air is delivered to individual work stations.

Finnegan, M.J., C.A.C. Pickering, and P.S. Burge, 1984, The Sick Building Syndrome: Prevalence Studies, British Medical Journ. 289: 1573-75.

The authors conducted a survey of nine office buildings, only two of which contained occupants experiencing sick building syndrome. Using doctor-administered questionnaires, they found a higher incidence of symptoms affecting the upper respiratory tract and mucous membranes in mechanically ventilated buildings, especially humidified buildings, than in naturally ventilated buildings.

The principal symptoms reported were headaches, lethargy, and chest tightness. The authors noted the symptoms of sick building syndrome do not represent a disease, but rather a reaction to the working environment. They concluded, however, that "the scale of [sick building syndrome] is probably considerable and the high degree of dissatisfaction . . . demands attention from architects, engineers, and the medical profession."

Finnegan, M.J. and C.A.C. Pickering, 1986, Building-Related Illness, Clin. Allergy 16: 389-405.

The authors conducted a review of the evidence for building-related illness and sick building syndrome to establish that proper maintenance of air-conditioning systems is an important contributing factor. They identify three main categories of diseases associated with air-conditioning systems:

physical (sick building syndrome); "allergic" (asthma, extrinsic allergic alveolitis, humidifier fever); and infections (bacterial, viral, fungal).

The authors describe the difficulties associated with developing a comprehensive definition for sick building syndrome, and note that the term is used to describe "a building in which complaints of ill health are more prevalent than one might usually expect.

Freund, A., C. Roy, and P. Siwczak, 1990, Success of Indoor Air Pollution Intervention Strategies, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. I, p. 587-591.

The authors report on the success of the state of New Jersey Health Department's program for investigating IAQ complaints. They evaluated 221 cases received over a 56-month period, and found that inadequate fresh air or stuffiness was the most frequently reported hazard (43 percent of the cases).

In two-thirds of the cases in which complete health data were available, 20 percent or more of the exposed employees reported experiencing health symptoms related to IAQ problems. In addition, upper respiratory illness accounted for 10 percent of all reported symptoms, and were reported in 24 percent of the 221 IAQ cases.

Maintenance, repair, readjustment, and/or redesign of the HVAC system was the recommended strategy in the vast majority of cases in which abatement recommendations were either implemented or planned. Among cases in which abatement was implemented and documented, 84 percent reported the elimination of health symptoms.

The authors defined IAQ cases as a request for assistance after one or more of the following problems was reported: IAQ/poor air, temperature discomfort, inadequate fresh air/stuffy, stale air/unspecified odor, microbial contamination, or low relative humidity.

The authors reported an overall success rate greater than 50 percent, and found that the use of a ventilation assessment guide generally was successful in identifying the sources of complaints. They expressed concern that the ventilation guide was not used in many cases, and suggested the need for a regulation to require systematic evaluation of indoor environments once health symptoms are reported.

Hodgson, M.J., P.R. Morey, J.S. Simon, T.D. Waters, J.N. Fink, 1987, An Outbreak of Recurrent Acute and Chronic Hypersensitivity Pneumonitis in Office Workers, Amer. J. of Epidem. 125(4): 631-638.

The researchers investigated three episodes of an acute, flu-like illness associated with manipulations of the central air handling system of an office building. The symptoms were compatible with acute hypersensitivity pneumonitis, but could not be attributed to a single microbial agent or endotoxin. The authors concluded that the results indicate the disease may result from a cumulative reaction to a number of organisms in the air, or from immunological differences in those occupants developing illness.

Despite a lack of clinical analysis, the authors concluded the existence of chronic disease in the building, noting that persons with acute disease were more likely to have some form of chronic disease. Chronic disease was associated with the presence of humidifiers at home, although the disease was found to be unrelated to current humidifier use. The authors postulated that "persons become sensitized to antigens through additional exposure at home" or that "persons with chronic respiratory complaints use humidifiers at home."

As a result of the incidence of illness, the building was vacated and (at the time of the article) remained vacant.

Hodgson, M.J., 1988, Health Risks of Indoor Pollutants, in Proceedings of ASHRAE Engineering Solutions to Indoor Air Problems Conference (IAQ 88), April 11-13, Atlanta, Georgia, p. 284-293.

The author reviews the data on health risks associated with exposures in indoor air. As part of this review, he summarizes WHO's four levels of work-related disease: (1) disease caused only by work exposure; (2) disease caused, among others, by work exposure; (3) diseases to which occupational exposures contribute; and (4) diseases where occupational exposures exacerbate a pre-existing condition.

The author presents information on the impact of bioaerosols, VOCs, combustion products, and radon on IAQ, and offers a considerable amount of quantitative data on bioaerosol contamination including:

- o Legionella species account for 8-10 percent of community-acquired pneumonias, or 50,000 to 60,000 illnesses, annually.

- o While only 2-3 percent of individuals in unselected mechanically-ventilated buildings complained of symptoms associated with humidifier fever, attack rates in workplace epidemics have generally been 30 to 75%.
- o Humidifier fever and hypersensitivity pneumonitis may occur, at least intermittently, in 1 to 4 percent of the 20 to 30 million office workers.
- o Episodes of acute respiratory disease are estimated to cost in the range of 150 million days and \$59 billion annually.

The author notes that there is growing evidence that biological aerosols contribute to the symptoms generally termed "sick building syndrome." In addition, the author notes that little quantitative data exists to associate health effects with levels of VOCs, combustion products, and radon typically found indoors.

Jaakkola, J.J.K., L.M. Reinikainen, O.P. Heinonen, A. Manjanen, and O. Seppanen, 1991, Indoor Air Quality Requirements for Healthy Office Buildings: Recommendations Based on an Epidemiologic Study, Environ. Intern. 17: 371-378.

The authors conducted a epidemiological study of occupants of a modern eight-story office building in Helsinki during the winter months after workers had exhibited symptoms typical of sick building syndrome. Ventilation rates in the building were generally high (26 liters/sec/person average) but varied considerably and no association with symptoms was found. After an experimental reduction in ventilation rate, however, a statistically significant association between ventilation and symptoms was seen.

The authors monitored a number of indoor parameters. Room temperature was found to be the most important indoor air determinant of symptoms. Low humidity also was viewed as a problem by a significant percentage of occupants. Levels of measured indoor air pollutants were far below those known to cause adverse health effects.

The authors specify temperature, humidity, and ventilation rate requirements for healthy (healthful) office buildings, in addition to advocating the importance of individual control of the environment.

Jaakkola, J.J.K., O.P. Heinonen, and O. Seppanen, 1991, Mechanical Ventilation in Office Buildings and the Sick Building Syndrome: An Experimental and Epidemiological Study, Indoor Air 2: 111-121.

The effects of varying the ventilation rate on the incidence of sick building syndrome symptoms were studied in an office building where the ventilation system was blamed for causing such symptoms. The authors found that experimental reduction of the ventilation rate did not alleviate the symptoms, but instead caused a slight but statistically significant increase in symptoms.

In addition, the study found that temperatures above 22°C were positively correlated with symptoms, as was any prior history of allergic diseases and a negative attitude towards the social atmosphere at work. The authors also note that the incidence of sick building syndrome is a complex phenomenon, and that study design is crucial in controlling confounding factors in IAQ investigations.

Janssen, J.E., T.J. Hill, J.E. Woods, and E.A.B. Maldonado, 1982, Ventilation for Control of Indoor Air Quality: A Case Study, Environ. Intern. 8: 487-496.

An automatic, variable ventilation system, based on CO₂ level, was installed in a section of a Minnesota junior high school to determine the potential impact on energy consumption and occupant response. The system was found to provide a 20-percent energy savings, without a significant difference in comfort. The energy reduction was achieved by means of a CO₂-feedback control system that was responsive to the occupancy load.

The authors also note that the location of supply and return air terminals significantly affect the air mixing within the occupied spaces. The mixing of air within the space is characterized as ventilation efficiency, and is associated with energy consumption.

Kreiss, K.K., and M.J. Hodgson, 1984, Building-Associated Epidemics, in P.J. Walsh, C.S. Dudley, and E.D. Copenhaver (eds.), Indoor Air Quality, CRC Press, Boca Raton, Florida, p. 87-106.

The authors review the available data on outbreaks of building-related complaints. They delineate the following four major etiologies for such outbreaks: 1) hypersensitivity-type

diseases that occur when antigenic material is widely disseminated from contaminated water or filters in air-handling systems; 2) infections that occur when viable microorganisms are disseminated through the air from their source in air-handling systems, whirlpools, etc.; 3) specific illness related to exposure to specific chemicals (e.g., CO); and 4) widespread complaints of mucous membrane irritation, headaches, and fatigue that appear to be caused by low levels of many contaminants associated with low fresh air ventilation rates.

LaForce, F.M., 1986, Airborne Infections and Modern Building Technology, Environ. Intern. 12: 137-146.

The author reviews the evidence for airborne infection in indoor environments. He outlines the conditions and pathogens that can lead to biocontamination, and the diseases that can result. He points to the following important conditions for the introduction of bioaerosols into indoor air and methods for controlling them:

Example	Reservoir	Buildings at Special Risk	Control Measures
1. Infection related to cooling towers	Cooling tower or evaporative condenser	Any building with such devices	a. Maintenance and biocide treatment of cooling towers and evaporative condensers. b. Attention to location of intake vents in relation to cooling tower drift.
2. Microbial pollution of intake air	Environment	All buildings but particularly hospitals	a. Review location of intake vents (particularly important with construction projects). b. Check adequacy and condition of filters.
3. Contamination of air ducts	Air ducts	Hospitals (areas with immunosuppressed patients)	a. Special problem requiring investigation, particularly with increased incidence of Aspergillosis in immunosuppressed patients. b. May require special cleaning of ducts or attention to filters.
4. Airborne disease related to humidifiers and window air conditioners	Humidifiers and air conditioners	Any building with such devices and cases of allergic alveolitis	a. Routine cleaning of humidifiers and air conditioner water. b. Banning of such devices.
5. Airborne infections with internal construction	Internal building materials contaminated with Aspergillus	Hospitals	a. Careful consideration of moving immunosuppressed patrons from environment during construction. b. Care to use barriers to limit airborne spread.
6. Person-to-person spread via airborne route	Infected humans	Hospitals	a. Proper isolation of infected patients. b. Insuring that isolation rooms are under negative air pressure.

Mendell, M.J. and A.H. Smith, 1990, Consistent Pattern of Elevated Symptoms in Air-Conditioned Office Buildings: A Reanalysis of Epidemiologic Studies, Amer. J. Public Health 80(10): 1193-1199.

The authors conduct a reanalysis of data from non-complaint building studies to determine if there are consistent relations between prevalence of specific symptoms and certain building ventilation factors. Data from six comprehensive studies of worker symptoms in multiple office buildings were selected. Buildings were divided into five standard categories of ventilation type, and symptoms were organized into four groups. The reanalysis suggests that sealed buildings with air-conditioning are associated with higher prevalence of work-related headache, lethargy, and eye, nose, and throat symptoms than unsealed buildings with no air conditioning.

The authors conclude that the patterns of association in the reanalysis suggest that symptom reporting is systematically related to still unidentified factors in sealed, air-conditioned buildings. They offer the following possible ventilation-related risk factors: inadequate fresh air ventilation, reduced thermal comfort, use of bacteriacidal agents, and recirculation of infectious or allergenic biological agents. While they note that sufficient data are not available, they conclude that the results are consistent with increased exposure of workers to biologic aerosols from water within the ventilation system.

Platt-Mills, T.A.E. and M.D. Chapman, 1987, Dust Mites: Immunology, Allergic Disease, and Environmental Control, J. Allergy Clin. Immun. 80(6): 755-775.

The authors review the data on the occurrence and impact of dust mites in home and office environments. They note that mite allergy has been associated with perennial rhinitis, asthma, and atopic dermatitis and suggest that methods are becoming available for controlling dust mites and for determining quantities of mite allergens associated with an increased risk of allergic disease.

The authors point out that while little research has been conducted regarding dust mites in offices, studies indicate that humidity in office buildings is sufficiently high to support fungi growth and to indicate that dust mites are contributing to IAQ problems.

Robertson, A.S., P.S. Burge, A. Hedge, J. Sims, F.S. Gill, M. Finnegan, C.A.C. Pickering, and G. Dalton, 1985, Comparison of Health Problems Related to Work and Environmental Measurements in Two Office Buildings with Different Ventilation Systems, British Medical Journ. 291: 373-376.

The authors conducted a cross-sectional survey of the worker population in two office buildings with differing ventilation systems. The prevalence of symptoms related to the work environment was assessed by a doctor-administered questionnaire. They found a significantly higher prevalence of rhinitis, nasal blockage, and dry throat, lethargy, and headache in the air conditioned/humidified building than in the naturally ventilated building. The authors conclude that most of the respiratory, eye, and nasal symptoms in the air conditioned buildings were related to the ventilation system. They could not attribute the higher incidence of lethargy and headaches to the ventilation system, and could not find a single environmental variable that explained the difference in symptom prevalence.

Sterling, E. and T. Sterling, 1983, The Impact of Different Ventilation Levels and Fluorescent Lighting Types on Building Illness: An Experimental Study, Canadian J. Public Health 74: 385-392.

The authors conducted a two-part experimental study to identify antecedents of complaints from office workers in a sealed, air-conditioned building. The study found that complaints and symptoms decreased when lighting was changed and ventilation increased, and increased again when previous conditions were restored.

Sundell, J., T. Lindvall, and B. Sternberg, 1991, Influence of Type of Ventilation and Outdoor Airflow Rate on the Prevalence of SBS Symptoms, in Proceedings of the ASHRAE Healthy Buildings Conference (IAQ 91), September 4-8, Washington, D.C.

The association between ventilation type and outdoor airflow rate and symptoms of sick building syndrome was measured in 160 office buildings of 10 or more employees in northern Sweden between January and April. Low outdoor airflow rates were found to correlate strongly with high prevalence of general symptoms, but not so strongly with mucous membrane and skin symptoms. The authors found no correlation between symptoms and type of

ventilation. They noted, however, that air conditioning systems with cooling and humidification, which have been correlated with high prevalence of symptoms, are rarely used in Sweden.

The authors concluded that outdoor airflow rate is important to the prevalence of symptoms associated with sick building syndrome.

Turner, S., 1991, Sick Buildings: Causes and Effects, in Proceedings of Indoor Air Quality and Health Symposium, October 24-26, Perugia, Italy, p. 207-212.

The author summarizes the result of studies of numerous modern buildings and provides a case history of a problem building. He notes that the three most common denominators of sick buildings are poor ventilation, inadequate filtration, and lack of maintenance. He concludes that, in over 80 percent of the problem buildings, the underlying cause was faulty operation and/or maintenance of building equipment.

Zweers, T., L. Preller, B. Brunekreff, and J.S.M. Boleij, 1990, Relationships Between Health and Indoor Climate Complaints and Building, Workplace, Job, and Personal Characteristic, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. I, p. 495-500.

The study investigates the relationship between the prevalence of work-related health and climate complaints and a number of building, management, workplace, and personal characteristics. The results show correlation of work-related complaints, in almost all cases, with gender, general work satisfaction, presence of CNSLD or allergies, and satisfaction with management's handling of complaints. The type of ventilation system was related to some of the complaints, as was humidification.

V. RESPONSES TO QUESTIONS RAISED BY REQUEST FOR INFORMATION

1. How would you define poor indoor air quality?

Both ASHRAE and the World Health Organization (WHO) have defined acceptable IAQ as air that is considered satisfactory by 80 percent or more of a building's occupants. This policy recognizes the significant technical and economic difficulties of providing indoor air that is acceptable to every occupant.

Poor indoor air quality generally has been defined by the presence of symptoms or health complaints rather than by identified characteristics of indoor air. The incidence of headache, skin and eye irritation, itching, drowsiness, dizziness, coughing, wheezing, digestive and sleep disorders, breathing difficulties, and a host of other building occupant complaints are included in the definition. These "symptoms," if reported to subside when the individual leaves the building, have been commonly referred to as "sick building syndrome" or "SBS." They are distinguished from specific illnesses such as hypersensitivity pneumonitis, humidifier fever, Pontiac fever, and Legionnaire's Disease, collectively referred to as "building-related illness," that result from exposure to certain biological contaminants in indoor environments.

The general symptoms of sick building syndrome likely result from a combination of factors, including the presence of chemical and biological contaminants. As pointed out by the National Research Council (NRC) in its 1987 report on indoor air quality

A number of factors are involved in the generation of building-related occupant complaints. Many of these can occur simultaneously.¹

The difficulty and complexity associated with identifying the source of occupant symptoms and complaints related to indoor air quality problems, therefore, make the establishment of a specific, or technical, definition for poor indoor air quality difficult or impossible.

The 1987 NRC report further concluded that "[i]t is rare that a specific source for the complaints can be identified, and solutions can usually be implemented without such identifi-

¹ NRC, 1987, Policies and Procedures for Control of Indoor Air Quality.

cations." As noted by NRC, "[t]he levels of both chemical and biological contaminants are strongly associated with the cleanliness of the heating, ventilation and air conditioning system." It may be more useful to establish a general definition of indoor air quality on the basis of the adequacy of the HVAC, therefore, than on the presence or absence of particular contaminants.

Despite these complexities, carbon dioxide (CO₂) concentration has been used as a quantitative indicator of the adequacy of the building ventilation for normal occupant activities and, consequently, as a measure of IAQ. In fact, the ventilation rate of 20 cubic feet per minute (cfm) specified in ASHRAE Standard 62-1989 is based on maintaining a CO₂ concentration of 800 parts per million (ppm) or below.²

2(a). What data are available that associate adverse health effects with exposure to the following types of indoor air contaminants - chemical agents, bioaerosols, passive tobacco smoke, radon?

A considerable amount of health effects data is available for many contaminants that have been observed in indoor environments. These data form the basis for the Agency's permissible exposure limits governing many workplace environments. For the most part, however, this information does not suggest the potential for adverse human health effects at the relatively low contaminant concentrations found in indoor non-industrial workplaces. For some contaminants, little data have been generated regarding adverse health effects at low concentrations. For most contaminants there is no information on the effects of particular mixtures. There is, however, considerable information regarding the health effects of poor ventilation and poorly maintained ventilation systems (see above).

The IAQ issue has focused in large part on effects that have not generally been viewed as "adverse health effects" by OSHA or other agencies, such as worker absence, and loss of productivity. While important, therefore, the symptoms of poor indoor air quality fall outside the traditional boundaries of OSHA's regulatory activity.

² ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air, Appendix D: Rationale for Minimum Physiological Requirements for Respiration Air Based on CO₂ Concentration.

To some degree, however, bioaerosols represent an exception to this general paradigm. Our current understanding of their potential health impacts is incomplete in some cases and anecdotal in others. Moreover, the potential health effects from some contaminants (e.g., Legionella) can be extreme. Certainly, the role of biologicals in causing some effects is large, even with this incomplete understanding.³

- 2(b). Based on observations in your workplace or your knowledge of research results, describe the adverse effects that you believe may be attributable to the quality of indoor air..**

As noted in Section IV of these comments, the potential health effects resulting from poor IAQ range considerably. In general, the effects include those symptoms attributed to "sick building syndrome" and loss of worker productivity.

There is significant overlap in the symptoms experienced by occupants in cases of "sick building syndrome" and, as embodied in the definition of the syndrome, it is not possible to identify the specific causative agent(s), except in some cases of building-related illness.

- 2(c). What percent of the workforce suffers adverse health effects due to poor indoor air quality in their workplace? What is the basis for your estimates?**

According to the data that have been collected, the incidence of office workers experiencing symptoms attributed to poor IAQ ranges from 20 to 30 percent. These estimates are drawn from the following three sources:

- o An investigation of 600 office workers in the United States found that 20 percent experienced symptoms and most of these individuals

³ Testimony of Dr. Harriett A. Burge before the Subcommittee on Health and the Environment, U.S. House of Representatives, April 10, 1991.

believed their work efficiency was reduced.⁴

- o The World Health Organization data indicate that up to 30 percent of new and remodeled buildings may be affected by sick building syndrome.⁵
- o A study of over 4,000 workers in 46 buildings found that 29 percent experienced five or more symptoms of sick building syndrome.⁶

Until a comprehensive analysis of the available data is conducted, however, it may be difficult to extrapolate the results from a single study to the general workforce.

2(d). Based on observations in your workplace or your knowledge from other sources, how much lost work time and decreased productivity may be traceable to illnesses related to poor indoor air quality? What is the basis for your estimate?

2(e). Are there any other indicators of workers' illnesses related to poor indoor air quality?

Little quantitative data exists on lost work time and decreased productivity related to poor IAQ. Woods has estimated the costs of decreased productivity due to absenteeism or lost concentration (excluding medical costs or lost sales) to be \$10

⁴ Woods, J.E., J.E. Janssen, P.R. Morey, and D.R. Rask, 1987, Resolution of the "Sick" Building Syndrome, in Proceedings of the ASHRAE Practical Control of Indoor Air Problems Conference, May 18-20, Arlington, Virginia, p. 338-348.

⁵ World Health Organization (WHO), 1986, Indoor Air Quality Research, Report of a WHO Meeting, EURO Reports and Studies 103, Copenhagen.

⁶ Burge, P.S., A. Hedge, S. Wilson, J. Harris-Bass, and A.S. Robertson, 1987, Sick Building Syndrome: A Study of 4373 Office Workers, Ann. Occup. Hygiene 31: 493-504.

billion dollars per year.⁷ This estimate is based on his estimates of the IAQ in the existing building stock in the United States (see response to questions 2b and question 4).⁸

A study of four Army training centers found that the incidence of acute respiratory disease⁹ was at least 50 percent higher in new, mechanically ventilated barracks than in older, naturally ventilated barracks.¹⁰ These results were attributed to the decrease in IAQ associated with closed ventilation systems, and led the authors to conclude that such systems can increase the risk of respiratory-transmitted infection.

While they are not all related to IAQ problems, respiratory ailments accounted for half of all U.S. employee absenteeism from acute conditions between 1983 and 1985 according to the National Center for Health Statistics. This amounts to about 150 million lost work days.^{11,12}

3. What correlation, if any can be made between symptoms presented in IAQ complaints and type of causative agent? For example, are certain symptoms more

7 Woods, J.E. 1990, Presentation to the Fourth National Indoor Air Quality Conference, Consumer Federation of America, October, Washington, D.C.

8 Woods, J.E., 1990, Continuous Accountability: A Means to Assure Acceptable Indoor Environmental Quality, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. 5, p. 85-94.

9 Acute respiratory disease was defined as the presence of fever plus one or more respiratory symptoms, and can be equated with lost work time.

10 Brundage et al, 1988 (see Section IV).

11 Garibaldi, R.A., 1985, Epidemiology of Community Acquired Tract Infections in Adults, Amer. J. Med. 78(supp. 6B): 32-37.

12 Dixon, R.E., 1985, Economic Costs of Respiratory Tract Infections in the United States, Amer. J. Med. 78(supp. 6B): 45-51.

indicative of exposure to chemical contaminants as opposed to biological contaminants? Please give examples.

Other than cases of Legionella and other building-related illnesses,¹³ little evidence exists for associating symptoms with a specific indoor air contaminant or contaminants. Indoor environments generally contain low levels of a wide variety of biological and chemical contaminants. In addition, incidences of poor IAQ usually stem from reports of a very broad range of generic symptoms, including thermal discomfort, odor, regardless of the individual situation or the "mix" of contaminants.

In the case of an outbreak of Legionella, the symptoms are specific and the treatment method of the victims clearly understood. Moreover, the need for elimination of the causative organism from the cooling towers of the building is clear. In a case of sick building syndrome, on the other hand, the symptoms of the building occupants are far more general. In addition, the removal of any one individual contaminant does not guarantee a permanent solution, and the only clear method for relieving symptoms is to remove the occupants from the building until the conditions which may have contributed to the complaints can be remediated.

Attempts to determine the particular causative agent or agents, therefore, are usually complex and often futile. As a result, approaches that address a broad range of contaminants, like the building-systems approach, offer a far more comprehensive and cost-effective and less time-consuming solution.

4. At least one report (Woods, 1989) estimates that between 800,000 and 1.2 million commercial buildings in the United States have problems that may be classified as Sick Building Syndrome, potentially affecting some 30 to 70 million occupants. The Agency solicits additional data relevant to the development of more precise estimates of the number of workplaces with indoor air quality and the number of employees adversely affected.

As described in the response to question 2(c), estimates by the World Health Organization (1986) and by Burge et al (1987) are largely consistent with those of Woods.

¹³ See response to question 1.

- 5(a). In cases where IAQ investigations have identified a bioaerosol as the etiologic cause of building-related illness, did complaints occur within a specific length of time?
- 5(b). Were there similarities in symptoms among affected individuals which suggested exposure to a specific agent (e.g., Legionella pneumophila)? Was the etiologic agent identified?

Symptoms associated with building-related illness generally occur within 3 to 4 hours after significant contamination by the causative agent has occurred.¹⁴ In those instances where biological contamination was believed to be the cause of less severe IAQ complaints, however, the symptoms reported by building occupants did not appear to occur within a specific period of time and generally were the same as most reported cases of "sick building syndrome."

- 5(c). What laboratory tests were performed to confirm that a specific bioaerosol was responsible for health complaints?

Laboratory tests are available for confirming the presence of many specific biocontaminants. BCIA strongly believes, however, that proper operation and maintenance of building systems will prevent the accumulations of any specific contaminant. In addition, however, BCIA believes that aerosol and surface microbial sampling should be conducted as part of any IAQ investigation.

- 5(d). How was the [bioaerosol] problem resolved?

Beyond routine inspection and maintenance of HVAC systems and regular replacement of filters, the use of disinfectants, biostats and biocides, and/or antimicrobial treatment appears to be an effective method for controlling bioaerosol problems. While these techniques can be effective, problems can arise with some if they are not properly administered.

¹⁴ Hodgson et al, 1987 (see Section IV).

- 6(a). Are there other data [aside from those from NIOSH] which indicate the prevalence of biological contaminants as the cause of adverse health effects? If so, please indicate the source of such data?

Biological contaminants in industrial and nonindustrial environments encompass a wide range of contaminants pollutants including bacteria, fungi, viruses, exoskeletons of mites and insects, animal dander, dead human skin tissue, allergens, and mycotoxins. Microorganisms can survive and grow in numerous indoor environments that provide moisture and nutrients.

There is an abundance of recent data indicating that NIOSH has significantly underestimated the prevalence of biological contamination, and that such biocontamination is a major contributor to indoor air problems. Data from BCIA members and other private firms indicate that it may be the cause of 40 to 50 percent of the indoor air problems in commercial buildings. Moreover, recent information collected by the Consumer Product Safety Commission (CPSC) indicates that 30 to 50 percent of all structures have damp conditions that may encourage the growth of biological contaminants.¹⁵

Moist places, including ventilation and humidification systems, generally have the necessary pH, temperature and nutrients for the amplification of microorganisms. For example, Burge et al reported the presence of thermophilic bacteria in air and water samples in up to 72 percent of all furnaces and in 43 percent of all console humidifiers.¹⁶ They also reported mesophilic fungi in 60 percent of furnaces and 72 percent of console humidifiers.

¹⁵ CPSC, 1989, Summaries of Workshops on Biological Pollutants and Asbestos Abatement in the Home.

¹⁶ Burge, H.A., W.R. Solomon, and J.R. Boise, 1980, Microbial Prevalence in Domestic Humidifiers, Appl. Environ. Microbiology 39: 840-844.

8. Some people may develop an increased sensitivity to chemical pollutants, such as [passive tobacco smoke], during pregnancy or treatment with certain medications (Calabrese, 1978). What additional studies pertain to this sensitivity?

While several instances of increased sensitivity to specific contaminants do exist, there is considerable question about anecdotal data suggesting the possibility that a small group of the population has become sensitive to a wide variety of contaminants in the environment. These individuals report that they suffer acute reactions repeatedly upon exposure to levels commonly encountered in indoor environments that would not affect most people, a phenomenon known as environmental illness or multiple chemical sensitivity (MCS). People thought to be suffering from environmental illness are believed to have acquired a disease, perhaps immunologic in origin, resulting in a heightened sensitivity to a wide variety of synthetic chemicals, ingested foods, and drugs. Symptoms may be multiple, wide ranging, and non-specific.

There are no laboratory tests that can diagnose environmental illness, no well-established signs and symptoms, and no specific pathogens have been identified which can then be treated. Several independent studies of individuals diagnosed of as having environmental illness indicate that psychological/psychiatric factors contribute to some or all of the symptoms exhibited.^{17,18} Although most health professionals express doubt that environmental illness has an organic basis, it is clear that a significant number of people report a syndrome that does not conform to our present understanding of immunologic or allergic diseases.

Clearly, it is extremely important that the issue of environmental illness be resolved and the significance of environmental exposure be established. Toward this end, a research program should focus on the clarification of the medical/physiological/psychological nature of the syndrome, and should be directed toward:

¹⁷ Terr, A.I., 1989, Clinical Ecology in the Workplace, J. Occup. Medicine 31(3): 257-261.

¹⁸ Black, D.W., A. Rathe, R.B. Goldstein, 1990, Environmental Illness: A Controlled Study of 26 Subjects with '20th Century Disease', J. Amer. Med. Assn. 264(24): 3166-3170.

- o Investigating the role of specific toxicologic mechanisms, both immunological and otherwise;
 - o Determining whether specific health impacts actually occur from exposure to a variety of unrelated chemicals;
 - o Distinguishing between hypersensitivity and MCS; and
 - o Avoiding unnecessary testing by employing a tiered approach to research.
9. OSHA requests data on the annual incidence rate of chronic obstructive lung disease, asthma, and allergies in the general population. If available, these data will assist the Agency in estimating accurate risk numbers.

It is estimated that about three percent of the population suffer from asthma.¹⁹ An estimated 20 percent of the nation's population have the genetic constitution to suffer from allergic rhinitis, allergic asthma, or allergic bronchopulmonary aspergillosis.²⁰ In addition, about 15 percent of hospital emergency room admissions have been attributed to dust mites and other airborne allergens.²¹ An estimated 5 million lost work days have been attributed to "environmental causes," including about 15 percent related to allergies.¹⁹

13. Have [psychosocial considerations, physical stresses such as temperature, lighting, noise, and ergonomics] been considered in instances where IAQ investigations have failed to identify a specific contaminant source? (b) If yes, was remedial action taken to improve these conditions? Please explain what that action was. (c) Did health complaints decline?

¹⁹ Hodgson, 1988 (see Section IV).

²⁰ Burge, H.A., 1988, Environmental Allergy: Definitions, Causes, Control, in Proceedings of ASHRAE Engineering Solutions to Indoor Air Problems Conference (IAQ 88), April 11-13, Atlanta, Georgia, p. 3-9.

²¹ Platt-Mills and Chapman, 1987 (see Section IV).

A number of studies have attempted to investigate the contribution of psychosocial and physical factors to occupants' perception of the indoor environment. (see Proceedings of Fifth International Conference on Indoor Air Quality and Climate, July 29-August 3, 1990, Toronto, Canada). In general, these studies indicate the complexity of factors that can contribute to IAQ complaints. BCIA believes it is important, however, to avoid attributing complaints to one or more of these other factors without first addressing the potential for poor IAQ. Nevertheless, several general conclusions can be drawn from the data that exist. It appears clear that job satisfaction and other psychosocial factors can contribute to IAQ complaints, although no more definitive conclusions likely can be drawn. Temperature, on the other hand, is clearly an important parameter. Most complaints from building occupants relate to temperature and humidity,²² and relative extremes of temperature likely contribute to the general perception of IAQ.

Studies by the National Institute of Occupational Safety and Health (NIOSH) and by private researchers have indicated that stressors such as noise, lighting and ergonomic factors may contribute to the overall perception of IAQ. Lighting and noise, in particular, have been found to significantly affect individual perceptions as to the suitability of their work environment. In addition to potential health effects, such as eye strain and hearing loss, insufficient lighting and high noise levels serve to increase the overall stress level of the work environment and can confound IAQ studies based on employee complaints.

The focus on video display terminals (VDTs) has stimulated interest in the relationship between ergonomics and work-related stress. The immobility of work stations, the isolation of the employee within that environment, and the low prospects for advancement from such positions all contribute to increasing the level of stress on VDT operators. While it is apparent that certain health complaints are common among VDT operators, it remains to be conclusively determined which problems are caused by VDTs and which can be more generally associated with the broader environment in which VDT operators work. To the extent that work conditions may be improved through relatively minor adjustments of noise, lighting and office configuration, ergonomics are likely to figure less significantly as confounding factors in IAQ investigations.

22 Testimony of Paul Cooksey, Building Owners and Managers Association, before the Subcommittee on Health and Safety, U.S. House of Representatives, July 10, 1991.

14. If your company keeps records of employee IAQ complaints, can you summarize your experience, emphasize your efforts to localize the problem, identify the contaminants, determine the adverse health effects, and action taken?

It generally is recommended that building managers keep a detailed log of unsolicited IAQ complaints as part of the building-systems approach to ensuring good IAQ. This will help to establish any trends or patterns in the spatial and temporal incidence of complaints. In addition, it may be advisable for individuals with complaints to seek an appropriate medical opinion.

The building-systems approach is based on a routine and comprehensive monitoring program to detect possible IAQ problems at an early stage. In addition to ensuring a more healthful and comfortable indoor environment, such a program also serves to increase employees' confidence in the building management program, protect against owner liability, and avert costly remediation measures.

15. Considering the wide variation in individual responses to chemical or biological exposures and other factors related to indoor air quality, what events should trigger an IAQ investigation?

BCIA strongly believes that the focus of any indoor air program should be to prevent, rather than mitigate, IAQ problems. This is the thrust of the building-systems approach.

For existing buildings, the building-systems approach includes testing, maintenance, and possible redesign and rebalancing of ventilation, filtration, heating, and air conditioning systems. A list of maintainability criteria for implementing the building-systems approach is provided as follows:

- o correct use of condensate drains, water baffles, mist eliminators, humidifiers, cooling towers, etc.
- o identification of access doors and/or inspection ports to chambers of air handling and ductwork systems
- o inspection of integrity, material type, and location of insulating materials associated with heating, ventilation, and air conditioning (HVAC) equipment, ducting and ceiling plenums

- o review of access to filters, coils, motors, reheaters, perimeter fan coils, and induction coils in variable air volume (VAV) and other air-handling unit components
- o evaluation of the adequacy, integrity, and fit of filters and the ease of their replacement
- o choice of filtration type and design, materials, and location within the ventilation system

Such a program, whether done in-house or by outside consultants, will help prevent occupant complaints in two main ways: 1) by ensuring proper ventilation, filtration, hygiene and operation/maintenance standards and reducing the likelihood of gross IAQ problems caused by these basic items; and 2) by communicating IAQ activities to building occupants, to provide a better sense of understanding by the occupants, who will see that their concerns are taken seriously. While these actions will not prevent the need for all further in-depth IAQ investigation, the need for the vast majority of reactive responses to IAQ problems will be eliminated. However, if IAQ problems do arise, BCIA believes that all complaints should trigger an appropriate form of response. No complaint should be dismissed as frivolous without a serious consideration of the nature of the complaint.

If the facts and circumstances of the situation establish a reasonable link between IAQ and health complaints, a complete on-site investigation (ventilation system inspection, possible remedial measures, etc.) is warranted. While the absence of this requisite background information does not preclude an on-site investigation, the effort becomes much less focused and the probability of success in finding a cause diminishes accordingly.

16. What physical evidence which might trigger an IAQ investigation (such as stagnant water, mold, broken fans, dirty vents, barriers to good air mixing, new carpeting/insulation) have been identified by you or your employees?

BCIA's building-systems approach advocates the routine inspection and maintenance of HVAC systems to prevent the development of IAQ problems. As a result of such routine maintenance and prompt replacement of filters and other HVAC parts, IAQ investigations generally should not be required. In conducting an IAQ investigation, however, a number of other signs of potential contributors to poor IAQ should be reviewed. In addition to those listed by OSHA, some others are: poorly maintained ventilation systems; poorly located air intakes and

exhausts; poor building construction; stains and odors; evidence of poor housekeeping; poor physical location of buildings; and evidence of electrical arcing causing production of ozone.

It is important, however, not to attempt to compile an all-inclusive list of "cookbook" signs to trigger an IAQ investigation, as the possibilities are limitless. Furthermore, investigators should be broadly trained, very open-minded regarding possibilities, attentive to the most minute details, and have excellent deductive abilities. As is true with any type of investigator, the ability to achieve acceptable results is highly dependent on the skills and experience level of the individual investigator.

BCIA also wishes to point out that the presence of new carpet or insulation does not necessarily imply that IAQ will be adversely affected or that a significant health risk may result. IAQ problems encountered with new products generally result from improper use or installation, inadequate ventilation, or a failure to address potential occupant exposure.

17. Dust mite infestations in indoor environments are implicated as a cause of allergic reactions and exacerbation of asthma. Recognized as a significant problem in residences, such infestations may be associated with similar complaints in occupational settings. (a) Has your workplace ever monitored for dust mites? (b) If yes, why was the monitoring conducted? (c) Did the results of the monitoring indicate a dust mite infestation? (d) What methods were used to determine the presence of dust mites?

The results of occasional sampling by a BCIA member involved in IAQ testing indicate that dust mites may be present to a significant degree in as many as 25 percent of office buildings. In addition, recent study of an 18-story office building in the United Kingdom found average levels of 5-10 mites per gram of dust in carpet, 0-8 mites/gram on hard surfaces, and 10-61 mites/gram on seats.²³

²³ Leinster, P., G. Raw, N. Thompson, A. Leaman, and C. Whitehead, 1990, A Modular Longitudinal Approach to the Investigation of Sick Building Syndrome, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate, July 29-August 3, 1990, Toronto, Canada, Volume I, p. 287-292.

18. Colony forming units (cfu) are the usual units used to express measurements of bioaerosols. What correlation, if any, can be made between the number for cfu per cubic meter of air and the potential to cause adverse health effects in susceptible individuals exposed to such contaminants?

The classes of microorganisms most often reported in studies of building-associated human illness include higher bacteria (e.g., actinomycetes) and fungi. Table 1 is a summary of the studies that have reported an association between contamination by microorganisms and building-related illness.²⁴ While associations can be made in some cases, and acceptable levels for certain bioaerosols have been suggested, that sufficient data generally do not exist to relate adverse health effects with particular biocontaminant concentrations.

In the case of fungi, for example, little serious attention has been paid to the hazards posed from inhalation exposure of filamentous fungi in indoor air. Recent epidemiological data from the United Kingdom, Canada, and the United States, suggest that health effects caused by inhalation exposure to mold propagules are more serious than thought.²⁵ Even less is known about mycotoxins produced by molds and other fungi. While recognized as a significant cause of several diseases, there is a lack of understanding of the basic mechanisms involved in the adverse health effects associated with exposure to mycotoxins.²⁶

Difficulty in establishing acceptable or guideline levels of biocontaminants is further complicated by the lack of a standard protocol for measuring biocontaminant levels. Methods do

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- ²⁴ Source: Cooper, C.A., 1990, Growth and Distribution of Microorganisms in Indoor Environments, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. 2, p. 3-8.
- ²⁵ Miller, J.D., 1990, Fungi as Contaminants in Indoor Air, Indoor Air '90, Vol. 5, p. 51-64.
- ²⁶ Schiefer, H.B., 1990, Mycotoxins in Indoor Air: A Critical Toxicological Viewpoint, Indoor Air '90, Vol. I, p. 167-172.

Table 1.

Summary of Studies Reporting Associations Between Saprotrophic Fungi & Actinomycetes and Building-Related Disease in Humans.

ACREMONIUM Isolated from humidifier water and air. (39) ALTERNARIA No antigen production found associated with humidifier fever. (6) Most prevalent fungal spores found in studies of three homes in Tucson, AZ., more prevalent indoors. (35) Frequently positive reaction among patients with respiratory conditions. (2, 24, 25) Isolated from humidifier. (10) 2.1% of total colonies found in indoor air in Oerebro, Sweden. (38) <i>A. tenuis</i>: isolated from humidifier. (18) ASPERGILLUS Fourth most frequently found fungal spores in studies of three homes in Tucson, AZ. (16) 1.3% of total colonies found in outdoor air and 6.2% of total colonies found in indoor air in Oerebro, Sweden. (38) Only found indoors in Copenhagen. (43) Predominant mold found indoors. St. Paul (47) Hypersensitivity skin test reactions in some allergic individuals. (2, 25) Predominant fungal spores in offices including: <i>A. chevalieri</i> (39) <i>A. repens</i> (39) <i>A. restrictus</i> (39) <i>A. glaucus</i> (18) <i>A. fumigatus</i>: Association with HF not found. (35) Isolated from humidifier. (10) Identified as causal agent for asthma AA due to contaminated humidifiers. (5) Source of aviculitis in non-atopic subjects. (25) <i>A. versatilis</i>: Predominant mold found in air of museum basement archives. (32) AUREOBASIDIUM <i>A. pullulans</i>: Source of antigen in HVAC systems. HP (1) Isolated from humidifier. (10) Second most frequently found fungal spores in	studies of three homes in Tucson, AZ. (16) 18% of total colonies found in outdoor air in Copenhagen. (22) 10% of total colonies found in indoor air in Copenhagen. (22) Predominant genus in undisturbed air in some homes. (London) (34) 6.6% of total colonies found in outdoor air in Oerebro, Sweden. (38) 5.6% of total colonies found in indoor air in Oerebro, Sweden. (38) BASIDIOMYCETE 5 - 17% reactivity to skin test of 10 species of gilled mushrooms. (33) CEPHALOSPORIUM Source of antigen in HVAC systems. HP. (1) <i>C. chaetomium</i>: Isolated from humidifier. (6) CLADOSPORIUM Isolated from humidifiers. (10) Presence found not associated with case of reported SBS-type symptoms. (28) Hypersensitivity skin test reactions in some allergic individuals. (2, 25) Occupied 1/2 of total colonies in sampling of subway station B. (51) Predominant in outdoor air in study on Spanish Coast. (31) Predominant genus in undisturbed air in some homes. (London) (34) Predominant genus found outdoors. (Stockholm) (40) Most prevalent mold found both indoors & outdoors. (Wales) (41) Predominant outdoors. St. Paul. (47) <i>C. cladosporioides</i>: Source of HP found in hot tub room. (30) <i>C. herbarum</i>: Found in room air. (17, 18) Able to decompose and use cellulose of all kinds of substrates: starchy limes, wallpaper, linen, and paint may be carbon sources. May grow at 86% relative humidity. (45) CRYPTOSTROMA <i>C. corticale</i>: Source of maple bark strippers disease. HP (21)	EXOPHIALA Isolated from humidifier water and air. (39) FUSARIUM Negative for antigen production for HP in humidifiers of ventilation air. (6) Isolated from humidifier water and air. (39) Isolated from humidifier. (10) Hypersensitivity skin test reactions in some allergic individuals. (2) HELMINTIOSPORIUM Fifth most frequently found fungal spores in studies of three homes in Tucson, AZ. (16) Found only outdoors in study on Spanish Coast. (31) Hypersensitivity skin test reactions in some allergic individuals. (2) HEMICOLA Isolated from humidifier. (10) HORMODENDRUM 53% of total colonies found in outdoor air in Copenhagen. (22) 1.2% of total colonies found in indoor air in Copenhagen. (16) Positive skin tests among patients with respiratory conditions. (24) Third most frequently found fungal spores in studies of three homes in Tucson, AZ. (16) 68% of total colonies found in outdoor air and 28% of total colonies found in indoor air in Oerebro, Sweden. Noticeable seasonal variation. (38) MORTIERELLA <i>M. zygliae</i>: Isolated from humidifier. (10) MUCOR Associated with allergic alveolitis from warm air heating system. (8) Produces hypersensitivity skin test reactions in some allergic individuals. (2) Positive skin test reactions among patients with respiratory conditions. (24) 0.7% of total colonies found in indoor air in Copenhagen. (22) 2.8% of total colonies found in indoor air in Oerebro, Sweden. (38) Always found in more abundance indoors. (Copenhagen) (43) OIDIODENDRON Isolated from humidifier. (10)	PENICILLIUM Associated with allergic alveolitis from warm heating system. (8) Hypersensitivity skin test reactions in some allergic individuals. (2) Dominant organism in case of HP. (7) Occupied 1/2 of total colonies in sampling of Subway Station. (51) Always found in more abundance outdoors. (Copenhagen) (43) Predominant mold indoors. St. Paul. (47) The only genus found more frequently indoors than outdoors. (Stockholm) (40) 1.3% of total colonies found in outdoor air in Copenhagen. (22) 59% of total colonies found in indoor air in Copenhagen. (22) Twenty times more plentiful indoors than outdoors in study on Spanish Coast. (31) Predominant genus in the undisturbed air in most homes. (London) (34) No seasonal variation. (38) 11% of total colonies found in outdoor air in Sweden. (38) 44% of total colonies found in indoor air in Oerebro, Sweden. (38) Predominant genus found both summer and winter from all sources. (49) Sixth most frequently found fungal spores in studies of three homes in Tucson, AZ. (16) <i>P. brevicompactum</i>: Isolated from room air. (18) <i>P. casei</i>: Cheese washer's disease. HP (21) <i>P. chrysogenum</i>: Isolated from rooms and Air Conditioners. (18) Source of AA associated with a faulty central heat system. (20) <i>P. cyclopium</i>: Source of AA associated with faulty central heat system. (20) Able to decompose and use cellulose of all kinds of substrates: starchy limes, wallpaper, linen, and paint may be carbon sources. May grow at 86% relative humidity. (45) PHIALOPHORA Negative for antigen formation associated with HP. (6) Isolated from humidifier water and air. (10, 39) PHOLIOTA <i>P. nameko</i>: HP source. (13)
PIROZIA Negative for antigen formation associated with HP. (6) 1.3% of total colonies found in outdoor air in Copenhagen. (22) 0.3% of total colonies found in indoor air in Copenhagen. (22) Isolated from humidifier. (10) Hypersensitivity skin test reactions in some allergic individuals. (2) RHIZOPUS <i>R. nigricans</i>: Frequent positive skin tests among patients with respiratory conditions. (2, 23) RHODOTORULA Isolated from humidifier. (10)	SCOPHARIOPSIS <i>S. brevicaulis</i>: May grow at 86% relative humidity. Able to decompose and use cellulose of all kinds of substrates: starchy limes, wallpaper, linen, and paint may be carbon sources. (45) SERPULA (Merulius) <i>S. pinastri</i>: Wood decay fungus source for allergic alveolitis. (23) <i>S. lacrymans</i>: Dry rot fungus associated with fungal spore allergy. (25) STACHYBOTRYS <i>S. atra</i>: Etiologic agent in toxicosis from contaminated ductwork and ceiling fiberboard. (46) THERMACTINOMYCETES (Higher bacteria)	Predominant source in certain studies of the antigenic substance in HVAC systems. HP source. Found in ducts, air conditioner, house dust and lung biopsy. (1) HP disease in almost all the patients was due to exposure originating from their home or office heating or AC systems. Found in up to 65% of homes in Milwaukee area. (21) <i>T. candidus</i>: Source of antigenic substance in HVAC systems. HP (1) HP (baggasosis, farmer's lung, or mushroom picker's lung. (3, 21) <i>T. thalophyllus</i>: Implicated in occupational and domestic lung diseases. (1) <i>T. saccharii</i>: HP source. (21) <i>T. vulgaris</i>: Isolated from office air. (17) Source of antigenic substance in HVAC	systems. (1) HP source (1, 21). Implicated in occupational and domestic lung diseases. (3, 25) <i>Foema rectivirgula</i>: Implicated in occupational and domestic lung diseases. (3) <i>Saccharomonospora viridis</i>: Implicated in occupational and domestic lung diseases. (3) <i>Micropolyspora faeni</i>: Isolated but association with HP not found. (6) Source of antigen in HVAC systems. Source of HP (19, 21, 25). Implicated in occupational and domestic lung diseases. (3) TRICHOSPORON <i>T. catenatum</i>: Isolated from pillow as source of HP. (4) WALLERIA <i>W. seidi</i>: Isolated from room ventilation air.

HP = Hypersensitivity Pneumonitis HP = Humidifier Fever AA = Allergic Alveolitis

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exist,^{27,28} and are used by BCIA members in IAQ investigations. No general consensus exists, however, concerning the relative merits of the available methods. While recognizing that certain limitations will undoubtedly remain, BCIA has encouraged the development of a consensus among researchers regarding a standard method for measuring contaminants. Until such a consensus is reached, it is very difficult to compare data collected from various investigators.

It may be instructive, however, to compare indoor and outdoor levels of biocontaminants. Such an approach has been suggested by the American Conference of Governmental Industrial Hygienists (ACGIH) bioaerosol committee for fungi,²⁸ and would help to minimize differences in sampling procedures. While the ratio of indoor to outdoor levels can not be directly related to the potential for adverse health effects, it may provide an indication of an indoor source of biocontaminants or a concentration mechanism.

19. What data, if any, are available that suggest that the effects of bioaerosols are influenced by seasonal changes?

Only limited data exist on the seasonal variation of bioaerosols levels. A study of non-complaint buildings found that saprophytic fungi levels (indoor and outdoor) were higher in spring and summer than in fall and winter, although the indoor/outdoor ratio appears to have been unaffected.²⁹ The study of Army trainees discussed in questions 2d and 2e found the incidence of acute respiratory disease to be higher in the winter

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- 27 Fradkin, A., 1987, Sampling of Microbiological Contaminants in Indoor Air, in J.K. Taylor (ed.), Sampling and Calibration for Atmospheric Measurements, ASTM Special Publication 957, p. 66-77.
- 28 Burge, H.A., M. Chatigny, J. Feeley, K. Kreiss, P. Morey, J. Otten, and K. Peterson, 1987, Guidelines for Assessment and Sampling of Saprophytic Bioaerosols in the Indoor Environment, Appl. Ind. Hyg. 2(5): R10-R16.
- 29 Holt, G.L., 1990, Seasonal Indoor/Outdoor Fungi Ratios and Indoor Bacteria Levels in Non-Complaint Office Buildings, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. 2, p. 33-38.

months in older, naturally ventilated buildings, but found no consistent seasonal pattern in mechanically ventilated buildings.³⁰

BCIA members also report incidences of elevated levels of fungi and allergens during particular times of the year. Such occurrences appear to be largely site-specific, and can not be used to draw any general conclusions.

- 20 (a) Have you made measurements of ventilation rates (in terms of air exchanges or CFM)? If so, what were the measurement results? (b) Have you sampled for bioaerosols or other contaminants (e.g., respirable suspended particles)? (c) Was there any correlation between the ventilation measurements and sampling results?

As described in Sections II and IV, there is a considerable body of evidence indicating that adequate ventilation does reduce levels of most indoor contaminants in properly designed and maintained buildings. Ventilation designs that do not provide effective space air distribution and, thereby reduce the ventilation effectiveness, will significantly decrease the ability of the HVAC system to provide adequate IAQ. Likewise, the placement of interior partitions and furnishings can diminish the ventilation effectiveness. Both situations may allow the accumulation of bioaerosols, particulates, and other indoor contaminants.

Improper maintenance of the HVAC system also will reduce its ability to remove indoor contaminants. Poorly fitting filters can allow particulates to remain in the air supply. Excessive moisture in the HVAC system may allow the multiplication of biocontaminants that can be rapidly spread throughout the building by the HVAC system.

Ventilation system contamination is of particular concern because operation of the system provides the means for aerosolization of microbial cells and products and results in human exposure. On the other hand, a properly functioning ventilation system will remove both internally and externally produced bioaerosols.

³⁰ Brundage et al, 1988 (see Section IV).

22. Do you have a specific data indicating that Variable Air Volume (VAV) systems are associated with more IAQ complaints than Constant Volume (CV) systems?

Data developed by a BCIA member indicate that constant-volume (CV) systems have higher ventilation efficiencies than variable air volume (VAV) systems. This data also suggests that energy-efficient air distribution systems, which minimize the amount of recirculated and outdoor air for significant portions of the operating time, such as VAV, are aggravating the IAQ problem. Moreover, BCIA estimates that some VAV boxes in as many as one-third of VAV systems are closed down completely because of improper design or maintenance.

Until recently it was assumed that air introduced into an indoor space contained particulates that, due to thermal mixing, dispersed like a gas and were removed from the indoor environment by the building's ventilation system. The underlying assumption, which appears to be incorrect, was that both the air and the contaminants were uniformly spread over the whole ventilation space.

As a result, greater emphasis must be placed on the effect of air-distribution patterns, especially where VAV ventilation efficiencies are likely to degrade during partial load conditions.^{31,32} The tests conducted suggest that where particulates tend to accumulate because of poor air-distribution patterns in office environments, the beneficial effect of air filtration is circumvented. This situation is severe in VAV systems serving interior zones (and exterior zones with high building envelope load components) which usually operate at minimum air volume loads for a percentage of the occupied period.

³¹ Meckler, M., 1991, Indoor Air Quality - From Commissioning through Building Operations, in Proceedings of the ASHRAE Healthy Buildings Conference (IAQ 91), September 4-8, 1991, Washington, D. C.

³² Shattuck, D.E., 1990, Can Variable Air Volume Systems be Compatible with Good Indoor Air Quality?, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. 4, p. 101-106.

23. What monitoring techniques other than ventilation rates do you use to measure indoor air quality in your workplace?

BCIA members routinely evaluate the ventilation system as a first step in attempting to identify the causes of IAQ problems. If particular problems are identified, they use a wide variety of tools to measure air quality including: microbial samplers (both airborne and contact), gas chromatography, radon detectors, titrametric methods, colorimetric methods (bench-top), CO₂ analyses, tracer gas tests, pressure tests, leak-detection tests, decontamination tests (spore strips), velocity tests, temperature, barometric pressure, and relative humidity measurements, particle counts, sorbent tube methods, colorimetric indicator tube methods, personal exposure badges, filter challenge methods of a variety of types, non-selective photoionizing devices, impinger methods, grab samples of many types, real-time sampling devices, and alarm systems.

While all of the above techniques can be useful in IAQ investigations, it also is important that the building's indoor air program include protocols for inspection and provisions for historical recordkeeping. Protocols will ensure that all components of the HVAC system are regularly inspected. Record-keeping of inspection and monitoring activities, while representing a minimum amount of additional effort, can serve as useful tools for OSHA or other organizations to review building operations, and for the building manager to demonstrate a record of proper maintenance and operation.

24. Current IAQ investigations indicate that ambient levels for specific substances are typically found to be within occupational exposure limits. (a) If your workplace has conducted air monitoring for specific substance, why was such sampling done? (b) For what substances did you monitor? (c) What were the concentrations for each substance? (d) What types of instruments were used in conducting the sampling? (e) How often did you conduct the sampling?

While air sampling can be a valuable tool for IAQ monitoring, BCIA believes that it should be viewed as only part of an overall approach to IAQ investigations. Other aspects of such an overall approach are discussed elsewhere in this comment. Monitoring should be conducted when evaluating the role of specific contaminants in the indoor air environment, based on information gathered in an initial site investigation.

25. Specifically, carbon dioxide at levels of 800 to 1,000 ppm has been a traditional indicator of poor indoor air exchange. (a) Have you conducted any carbon dioxide monitoring? (b) If so, what concentrations were found?

CO₂ levels are generally measured in IAQ investigations and can be a useful indicator of IAQ. ASHRAE's Standard 62-1989 specification for general office space is based on maintaining a CO₂ concentration at generally accepted levels (20 cfm - 800 ppm; 15 cfm - 1000 ppm).

BCIA members have observed CO₂ concentrations from 300 ppm to in excess of 2500 ppm, with an average range of 300 to 1000 ppm. Variations depend on the ventilation rate, occupant density, and human activity. As indicated in Figure 1, CO₂ levels closely tract human activity and, depending on the magnitude of infiltration, can rapidly decline to ambient levels at the end of the work day.

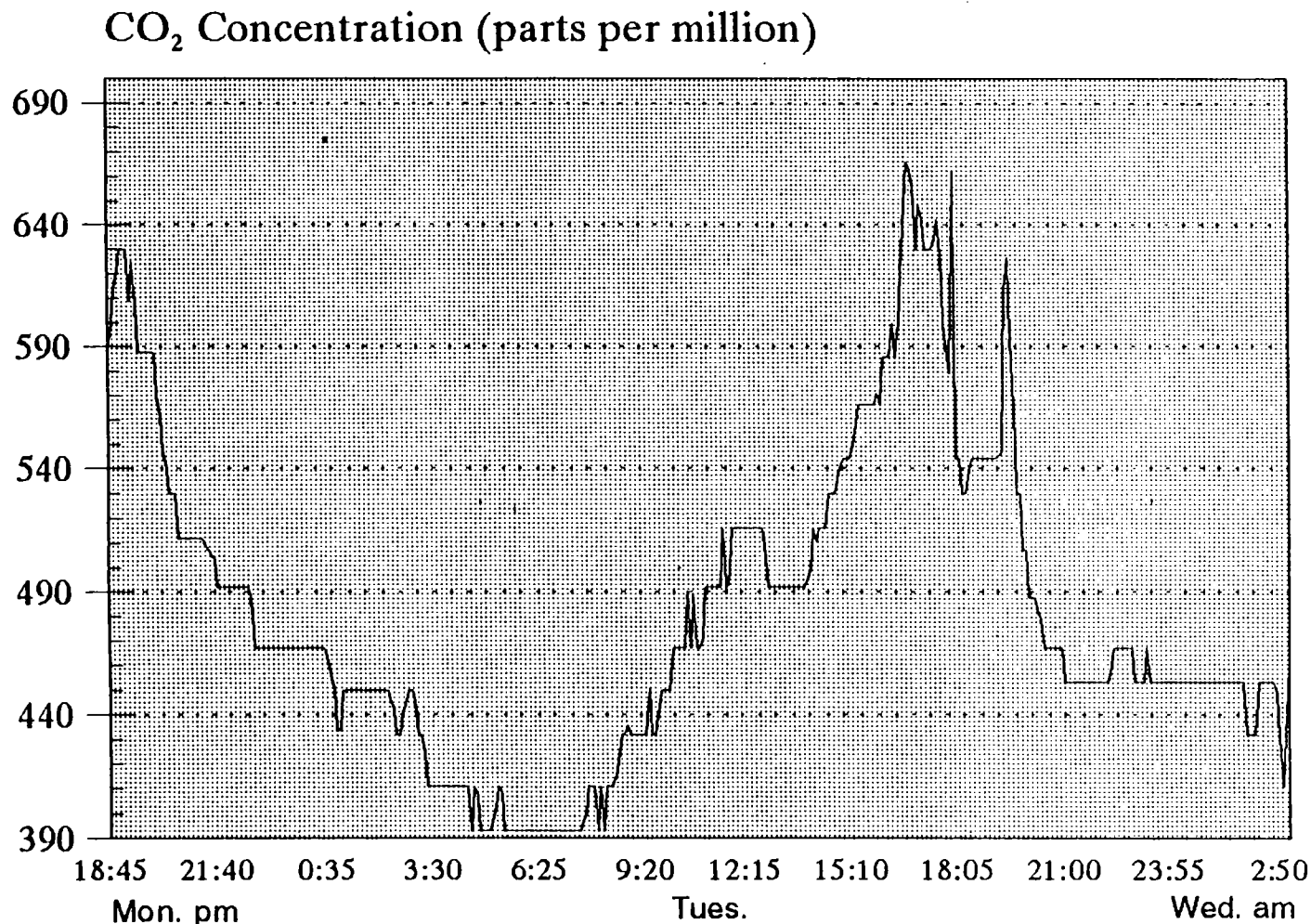
Caution must be used in interpreting CO₂ measurements. While they can be a useful indicator of the building's general ventilation rate, they can not be used as an indicator of air changes per hour within a particular room within the building. CO₂ levels may show considerable variation within the building, as a result of the local air distribution characteristics. Because of this local variation, measurements of mixed return air should be taken to provide the most representative values.

- 26(a). Is there any evidence to suggest that IAQ complaints coincide with specific amounts of specific volatile organic compounds (VOCs) in air (e.g., formaldehyde)? That is, can VOCs in mg/m³ be used as a measure of IAQ?

- 26(b). Are there practical sampling methods available for estimating total VOCs in air?

BCIA does believe that IAQ complaints have resulted from temporarily elevated VOC levels during renovation and maintenance operations, accidents, or other incidents. While many of these complaints likely are related to odor, rather than a specific health complaints, BCIA and others recommend that such operations be limited to non-working hours to the maximum extent practicable. As a general matter, however, BCIA is not aware of data associating IAQ health problems with VOC levels during normal building operations for a well designed and maintained building.

Figure 1. CO₂ Profile for Typical One-Person Office



Source: F. Gallo, Union Carbide Corp.

Because of the dynamic nature of indoor air, it would not be practical to monitor for the universe of specific VOCs of potential concern. Moreover, compliance with ventilation requirements as part of a building-systems approach will control VOC levels regardless of the specific components. Some have suggested, however, that the measurement of total VOC (or TVOC) may be a useful method for monitoring IAQ. Several methods have been proposed for determining TVOC levels,^{33,34,35} and the approach has been used to measure emissions from manufactured products.³⁶ In general, however, BCIA members have found field TVOC measurement to be difficult and impractical. This is further complicated by the lack of a standard definition for TVOC.

BCIA does not believe that sufficient data exist to suggest that the presence of VOCs at relatively low levels presents a potential health risk. EPA's Total Exposure Assessment Methodology (TEAM) data, while indicating elevated VOC levels in homes compared to ambient levels, did not attempt to correlate these data with building-systems conditions or symptoms.

Combining the levels of all chemical contaminants into one value does not distinguish among the potential health effects of the various contaminants. Specifying a long list of substances to be included in the measurement of total VOC does not provide any basis for relative comparisons. Alternatively, specifying a short list of contaminants would imply that environments without measurable levels of these few contaminants are "safe," which is inconsistent with the building-systems approach.

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- 33 Molhave, L., 1990, Volatile Organic Compounds, Indoor Air Quality and Health, in Proceedings of Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), July 29-August 3, Toronto, Canada, Vol. 5, p. 15-34.
- 34 Seifert, B., 1990, Regulating Indoor Air, Indoor Air '90, Vol. 5, p. 35-50.
- 35 Wallace, L., E. Pellizzari, C. Wendel, 1990, Total Organic Concentrations in 2500 Personal, Indoor, and Outdoor Air Samples Collected in the U.S. EPA TEAM Studies, Indoor Air '90, Vol. 2, p. 639-644.
- 36 Environmental Protection Agency, 1991, Carpet Policy Dialogue: Compendium Report, EPA/560/2-91-002.

27. NIOSH has developed guidelines for IAQ investigations (NIOSH, 1987). (a) If your workplace has conducted investigations, did you try an approach different from the NIOSH guidelines? (b) If yes, please explain how your approach differed from the NIOSH guidelines?

BCIA and its members have several concerns with the NIOSH guidelines. These guidelines are intended to investigate existing IAQ problems, not as a comprehensive method for maintaining adequate IAQ. In addition, the 1987 guidelines reference ASHRAE Standard 62-1981, rather than the new Standard 62-1989.

BCIA also is concerned about the widespread use of questionnaires as a method for assessing building IAQ. While focused questionnaires can be a valuable tool for IAQ investigations, BCIA believes they should only be used by the investigator during an occupant interview or distributed narrowly to individuals filing complaints and a limited number of other occupants. Widespread distribution of questionnaires will serve to heighten occupant's concerns and will give a false indication of the type and prevention of problems.³⁷ Such a subjective approach to data collection provides little technical information of value in an IAQ investigation.

BCIA also notes the considerable variation in building questionnaires,³⁸ and cautions against comparative analysis of information collected from several surveys. As has been generally established, the types and wording of questions can significantly affect the responses received.

Finally, and perhaps most importantly, BCIA does not believe that NIOSH devotes sufficient attention to biological contamination. We note that several methods currently are used by IAQ firms for airborne and surface sampling, and have encouraged NIOSH to improve its capability in this area.

³⁷ Menzies, R.I., R.M. Tamblyn, R.T. Tamblyn, J.P. Farant, J. Hanley, W.O. Spitzer, 1990, Sick Building Syndrome: The Effect of Changes in Ventilation Rates on Symptom Prevalence: The Evaluation of a Double Blind Experimental Approach, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), Vol. I, p. 519-524.

³⁸ Hedge, A., 1990, Questionnaire Design Guidelines for Investigations of "Sick" Buildings, Indoor Air '90, Vol. 1, p. 605-610.

32. In the absence of visible indicators of potential microbial growth such as water damaged carpeting or furnishings and accumulation of water and slime in HVAC components, what conditions would indicate the need for bioaerosol monitoring?

BCIA recommends that biological sampling be conducted as part of any IAQ investigation, regardless of the presence of visible indicators. Of primary importance, however, is the development of a standard protocol for microbial evaluations. Development of such a protocol will ensure that a thorough investigation is conducted, and will make the comparison of data from different surveys easier and far more meaningful. The protocol, for example, should include the identification of possible multiplication sites and dissemination routes.

- 33(a). If you suspect bioaerosol contamination, what sampling techniques do you use to determine the presence or concentration of such contaminants? (b) What have been the results? (c) Were remedial actions necessary? (d) If so, what actions did you take? (e) Did you re-sample following the initial actions? (f) Did it make a difference?

Possible sampling techniques include gravity plates, Andersen samplers, Biotest samples, sterile swabs (contact), contact strips, and specialized grab samplers for specialized tests (viruses, Legionella). The results obtained will depend on the nutrient media used to culture the samples, and no single procedure can provide a comprehensive picture of species composition. In addition, culture techniques do not measure non-viable bioaerosols (e.g., mycotoxins).

BCIA members have encountered a wide range of microbial concentrations in complaint buildings, from below the limits of detection to greater than 2000 cfu/m³, using generally accepted sampling techniques. In general, however, the average level is less than 1000 cfu/m³.

Remedial actions are recommended in many cases. In general, the recommended response is to control those environmental factors that promote propagation of microbes, including a thorough inspection of possible multiplication sites and dissemination routes. Temperature and relative humidity are often unacceptably high in buildings with high microbe concentrations, and modifications to HVAC or other environmental control systems are required to control the environment within narrower limits. Filtration can be an energy-efficient means to control microbes which is often overlooked.

Other recommended controls can include disinfection and decontamination, use of bacteriastatic/bacteriacidal paints to prevent reoccurrences, ultraviolet treatment, and changes to housekeeping and maintenance practices.

42. Some citations in the literature state the primary source of bacteria released into the indoor environment is the human body. Has your workplace addressed spatial considerations to prevent overcrowding and, thus, reduce the person-to-person spread of disease? How did you do this?

Human-source bioaerosols represent a significant source of biocontaminants in indoor environments, but their overall contribution will depend on the presence of other significant sources outside or within the building. The ventilation rates recommended by ASHRAE, however, generally are adequate to prevent significant accumulation of nonpathogenic human-source organisms.^{39,40} While these bacteria always are more abundant indoors, humans have adapted to tolerate their presence.

The spread of human pathogens indoors cannot be easily prevented, although evidence suggests that the presence of other persons in an office space increases the risk for common cold transmitted via indoor air.⁴¹

The four best methods for prevention of indoor microbial contamination are: (1) filtration to prevent penetration of outdoor aerosols; (2) maintenance of low relative humidity and a dry surfaces in ventilation systems and the prevention of flooding; (3) adequate outside air (fresh or filtered) to remove internally produced aerosols, and (4) good housekeeping to eliminate soil or other nutrient sources.⁴⁰

³⁹ Spendlove, J.C., K.F. Fannin, 1983, Source, Significance and Control of Indoor Microbial Aerosols; Human Health Aspects, Public Health Reports 98(3): 229-244.

⁴⁰ Burge, H.A., 1987 (see Section IV).

⁴¹ Jaakkola, J.J.K., O.P. Heinonen, O. Seppanen, 1990, The Occurrence of Common Cold and the Number of Persons in the Office Room, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), Volume I, p. 155-160.

43. Do you have evidence to show that overcrowding is a source of bioaerosol formation?

While overcrowding will facilitate the accumulation and spread of bioaerosols, BCIA does not believe that it will necessarily result in additional formation of bioaerosols. In a situation where bioaerosols are allowed to accumulate and grow, however, additional biocontaminant formation will occur.

44. Do you increase ventilation flow in particularly crowded worksites or conversely reduce ventilation during non-work hours?

BCIA believes that many building operators reduce their ventilation rates during non-work hours to reduce heating and cooling costs. Any accumulation of contaminants during these non-work hours, however, can be solved operationally. While many office environments use localized ventilation for particular contaminant sources (e.g., photocopiers), however, we do not believe that ventilation generally is increased in crowded worksites. In fact, information collected by BCIA members suggests just this opposite, that the inside (core) regions of the building generally receive less fresh air, especially in the summer. This results from the fact that air supply is generally based on heat load, rather than the occupant density.

45. Is it part of your company's policy to follow the ASHRAE Standard 62-1989 regarding the introduction of fresh outdoor air into the ventilation system?

BCIA believes strongly in the effectiveness of a building-systems approach to both preventing and solving indoor air quality problems. This approach can be defined as a comprehensive strategy that addresses the overall design of a building and the design, operation and maintenance of the HVAC system. An integral component of this approach is proper ventilation, such as is provided for in ASHRAE Standard 62-1989. Adherence to the principles contained in the ASHRAE 62-1989, applied in conjunction with sound HVAC operation and maintenance procedures, will dramatically improve the quality of indoor air and forestall the emergence of indoor air quality problems in many buildings which currently are operated at considerably lower ventilation rates.

Although the ventilation rates prescribed in ASHRAE 62-1989 are an important first step towards promoting good indoor air quality in the majority of buildings, much more attention needs to be devoted to building design, maintenance and inspection, as

well as the need for differing ventilation rates within a building.⁴² The average values stipulated in ASHRAE 62-1989 are an important minimum standard, but there may be instances in which it is necessary to adapt the general principles of the guideline to the specific circumstances of a given building.

46. Do you consider the specific type of work environment in determining the appropriate quantity of fresh air to introduce? For example, the ASHRAE recommended level for smoking lounges is 60 cfm/person as opposed to 20 cfm/person for regular office space.

ASHRAE Standard 62-1989 considers a variety of conditions which may affect the indoor environment, and calls for varying ventilation rates for each of those environments. In addition to establishing ventilation rates for nearly 90 different building applications, the ASHRAE standard also provides for the reduction or interruption of ventilation when a building is unoccupied. BCIA believes these considerations are an integral part of the standard and are necessary to ensure the greatest overall benefit from a technology-based approach to improving indoor air quality. Adoption of a single minimum ventilation rate without reference to other components of the standard (e.g., filtration, building layout, and occupant load) would oversimplify a necessarily multifaceted standard.

It also is important to note that ASHRAE permits the use of transfer air in areas requiring high ventilation rates to minimize the energy costs.

47. Do you believe one minimum acceptable cfm/person threshold exists for all indoor work environments which would successfully alleviate all health effects? What would you recommend that level to be? Please provide supporting information.

As noted previously, BCIA believes it is unrealistic to suggest that any IAQ strategy can successfully alleviate all health effects. As outlined by ASHRAE, Standard 62-1989 is designed to "minimize the potential for adverse health effects."

Because of the large number of factors that can contribute to IAQ problems, BCIA does not believe that specifying one minimum ventilation rate for all office situations can

practically ensure adequate IAQ. As outlined in Table 2 of Standard 62-1989 it is important to consider the occupancy and activity within a particular office space.

50. (a) Have you found that redesigning the workplace interior (e.g., as in renovation), leaving the ventilation system alone, results in improper distribution of air? (b) If so, what types of problems ensue after the remodeling?

Insufficient attention to the ventilation system during building renovation and reconfiguration occurs frequently, and can result in an improper air distribution and a significant lowering of IAQ. These IAQ problems can result from one or more of the following situations: (1) greater occupant density than specified in the original HVAC design; (2) blockage of supply air distribution by new partitions; (3) blockage of air ducts and diffusers; (4) poor temperature control resulting from new partitions; and (5) temporarily elevated contaminant levels during renovation. To facilitate consideration of the original HVAC system design during renovation, BCIA strongly recommends that each building owner maintain comprehensive and up-to-date information on the HVAC system.

In addition to determining and verifying the capacity of existing heating, ventilating and air conditioning (HVAC) systems based on the original design intent, one also has to determine if there have been any HVAC system modifications in the interim and, if so, what effect such modifications may have on the current HVAC system operational capabilities. These tasks can be accomplished by reviewing the design documentation, description of operation and maintenance tasks that must be performed on a regular basis, and the HVAC test and balance reports filed prior to the building. Where such documentation does not exist or where HVAC systems are determined not to have been tested and/or balanced recently, the building operator should perform an updated test and air balance report.

The HVAC air-distribution system should be reconfigured as needed to accommodate the occupancy of new space layouts by providing proper air-distribution to ensure maximum ventilation efficiency. An independent design criteria should address potential IAQ concerns in accordance with the latest applicable ASHRAE filtration, IAQ, and comfort standards rather than the minimum code requirements necessary for a plan check of the

building permit approval.^{43,44} One must also analyze the overall new system capacity to determine its adequacy for new thermal loads associated with the new reconfiguration.

Once the HVAC air-distribution system of a space is reconfigured, it should be thoroughly test-balanced. In addition, compliance of the HVAC system (anticipated full- and part-load conditions) with the new tenant plans and specifications developed by the architects and/or space planners must be verified. One must repeat these procedures until the performance of the reconfigured HVAC system is determined to be adequate.

51(a). ASHRAE set its recommendations assuming 100% fresh outdoor air introduction, but states that properly filtered, recirculated air at the same flow rates will adequately remove contaminants to acceptable levels. Do you agree with this statement?

51(b). Please provide information which supports recirculating filtered air as a healthy alternative to 100% fresh air introduction.

BCIA agrees with the ASHRAE statement that properly filtered and recirculated air will adequately remove contaminants to acceptable levels.

The Indoor Air Quality (IAQ) procedure of ASHRAE Standard 62-1989 (Appendix E) provides for the use of cleaned, recirculated air with both constant volume (CV) and variable air volume (VAV) ventilation systems. The IAQ Procedure can be used to verify the adequacy of the outdoor air ventilation rates obtained by the Ventilation Rate (VR) Procedure as well as to compute more directly the concentrations of indoor air contaminants within a given occupied space consistent with the concentrations specified in the Standard.

IAQ is directly related to outdoor air quality because ventilation employing outdoor air is essential to replace the oxygen consumed and to dilute indoor air contaminants (e.g., CO, CO₂) to an acceptable level. In fact, this strategy is the basis

⁴³ Meckler, 1991 (see footnote 31 on page 43).

⁴⁴ Such standards currently include ASHRAE Standard 62-1989, ASHRAE Standard 55-1981, and ASHRAE Standard 52-76.

for achieving acceptable IAQ by the VR Procedure, in which the rate of outdoor ventilation air to be delivered to an occupied space is specified.

A considerable amount of work has been conducted to determine the proper design of air cleaning and filtration systems that can ensure adequate IAQ at reduced ventilation rates. Two of these studies are included as Attachment 3. The use of air recirculation in conjunction with proper filtration and air cleaning (IAQ Procedure) may provide a more viable alternative for particulate control in buildings located in certain urban areas, and may offer the potential to reduce the associated energy cost of having to clean and condition dilution excess outdoor air. Filtration/adsorption is a well-established concept, based on proven technology, that has been widely used to protect human health. This technology exists in virtually every setting where human health is paramount and ventilation with (fresh) outside air is not acceptable option. Air cleaning, wisely coupled with minimal outside air, will yield optimum indoor air quality while also being the most cost-efficient method from an energy perspective.

In addition, there are new technologies emerging that offer an alternative to ventilation of indoor air contaminants to produce acceptable IAQ (see Attachment 4).

51(c). What types of problems are associated with recirculated air?

In using air cleaning/filtration devices, it is imperative that they be adequately sized and maintained. The equipment must have sufficient capacity to handle the expected containment load. The filtration medium requires regular replacement to ensure maximum efficiency, and the replacement filters must be of proper type and size.

- 52. (a) If you recirculate indoor air, do you seasonally adjust the amount of outdoor air your system takes in? (b) Have you observed any trends in illnesses or complaints which parallel the adjustments? (c). Have you observed any seasonal trends regarding illnesses or complaints independent of adjustments to the [ventilation] system?**

Most operators do seasonally adjust the amount of outdoor air entering the building. During temperate weather, for example, building operators maximize the amount of outside air to reduce the energy costs (economizer cycles). During other times

of the year, outside air generally will be minimized to reduce energy required to heat or cool it. In properly designed and maintained buildings, however, outside air dampers are never completely closed, always allowing at least a minimum of outside air in. Although there are a number of factors that can confound actual or perceived IAQ, one would expect that complaints, if experienced, would tend to be higher during minimum ventilation rates. Any trends, however, likely would be site-specific.

54. Is it possible to mitigate IAQ problems due to bioaerosol contamination just by properly maintaining the ventilation systems in respect to microbial growth, fungal growth, etc.?

BCIA believes that it is possible in most cases to prevent IAQ problems caused by biocontamination through a comprehensive HVAC inspection and maintenance program. Such a program should include regular inspection of all chambers and equipment for dirt and water accumulation, and prompt response to any problems encountered. In addition, filters of sufficient efficiency to remove respirable particles should be used and inspected to ensure proper fit. It also may be useful to include a biocide in condensate trays to prevent growth of biocontaminants.

55. What are the operating costs, exclusive of maintenance, for your ventilation system?

The extra energy costs incurred from increasing ventilation rates have figured prominently in debates over technology-based approaches to improving indoor air quality. Several studies of this issue, by both government and private industry, indicate that the increased total energy costs would be relatively small and typically in the range of 5 percent per year:

- o Eto and Meyer estimated that the cost of increasing the ventilation rates from 5 cfm per person to 20 cfm per person in 13 large office buildings in the U.S. and Canada would be less than 5 percent.⁴⁵

⁴⁵ Eto, J.H., and C. Meyer, 1988, The HVAC Costs of Fresh Air Ventilation, ASHRAE Journal, September, p. 31-35. (See Attachment 5.)

- o The Bonneville Power Authority⁴⁶ and the Department of Energy⁴⁷ have both estimated that the energy penalty for bringing ventilation rates into compliance with the ASHRAE standard would be in the range of 4 to 5 percent, regardless of the building's type or location.
- o The National Energy Management Institute conducted a study of a 100,000 square foot office building in the Washington, D.C. area and concluded that increasing the outside air intake from 5 to 20 cfm/person would increase annual energy costs by approximately 2 cents per square foot, or \$1,800 per year.
- o An analysis by Flatheim⁴⁸ concluded that increased energy consumption resulting from upgrading IAQ may total as much as 8 percent, but is more than compensated for by a 1-percent improvement in productivity.

BCIA recognizes that the energy costs associated with complying with the ventilation requirements of standard 62-1989 will depend on the local climate (see Figure 2). In certain cases, therefore, the use of air cleaning, filtration incorporated as part of the Standard likely will provide a cost-effective alternative. In addition, BCIA recognizes that the HVAC systems of some buildings may not have sufficient capacity to comply with ASHRAE's VR procedure. In such cases, HVAC retrofit likely would be prohibitively expensive, and alternative cleaning/filtration methods again will offer a viable solution.

⁴⁶ Steele, T. and M. Brown, 1990, Energy and Cost Implications of ASHRAE Standard 62-89, Bonneville Power Authority Report, January.

⁴⁷ Testimony of John P. Milhone, Deputy Assistant Secretary for Building Technologies, U.S. Department of Energy, before the Subcommittee on Health and the Environment, U.S. House of Representatives, April 10, 1991.

⁴⁸ Flatheim, G., 1990, IAQ Upgrades Do Not Ruin Budgets, in Proceedings of the Fifth International Conference on Indoor Air Quality and Climate (Indoor Air '90), Vol. 4, p. 59-64.

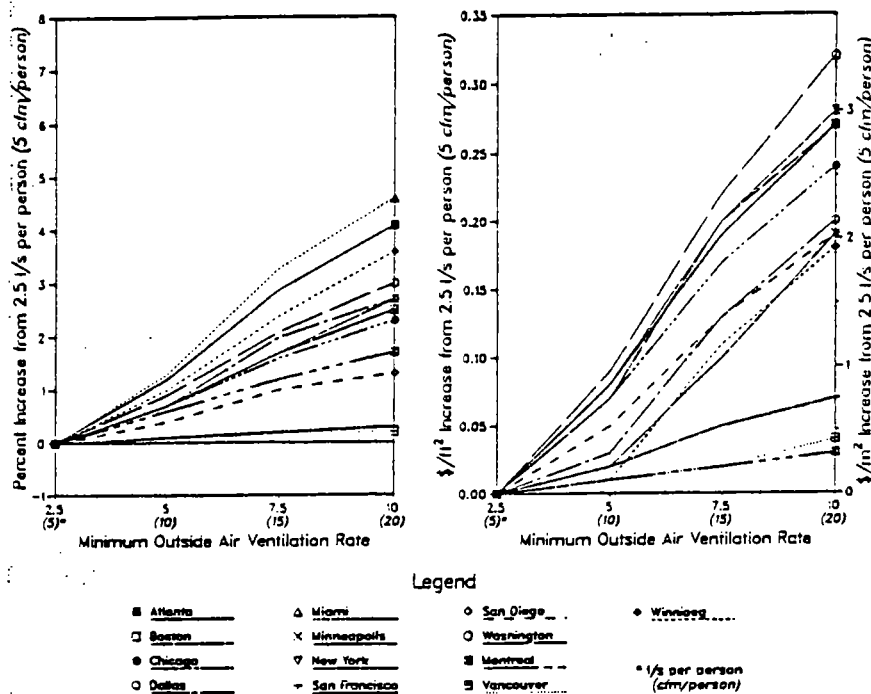


Figure 2. Annual Energy Costs and Cost of HVAC Systems as a Function of Minimum Outside Ventilation Rate (Eto and Meyer, 1988 - see Attachment 5)

56. What is your average cost per year for maintenance (in terms of cleaning, repairing, and replacement parts)?

BCIA would refer OSHA to the annual Experience Exchange Report compiled by the Building Owner and Managers Association (BOMA) for information on average maintenance costs. An excerpt from the 1991 BOMA report is included as Attachment 6.

57. If changes have been made to upgrade the ventilation system, why were they made and what were the costs associated with the mechanical improvements?

In general, HVAC systems are upgraded as part of major renovation efforts, and not because of IAQ concerns. As a result of the incorporation of ASHRAE Standards by regional, state, and local building code organizations, however, HVAC upgrades generally comply with the most current ASHRAE guidance.

Several reports of ventilation retrofits to resolve IAQ problems do exist. Attachment 7 includes a summary of three case studies prepared by Sterling et al.

59. Has your company experienced an increased insurance premium directly or indirectly attributable to poor indoor air quality?

BCIA is not aware of any companies that have experienced increased insurance premiums either directly or indirectly attributable to poor indoor air quality. However, at least one major insurer (CIGNA Corporation) is currently involved in testing related to this issue determine whether indoor air quality should be a factor in rate setting. In addition, AETNA Casualty and Surety Company offers IAQ investigation services to its clients either by request or as part of its regular loss-control visits.

69. Have you employed [control techniques other than increasing ventilation flow such as product improvement, filters and electrostatic precipitators, and adsorbing charcoal beds] to improve overall air quality inside your facility?

See response to question 51.

70. If yes, please describe the devices or techniques that you employed.

As described in our response to question 51, a number of alternative control devices or techniques are available. One of these systems employs ozone-accelerated catalysis to destroy indoor air contaminants (see Attachment 4). In addition, broad spectrum biostats have been developed as treatments for wall coverings, window treatments, flooring systems, upholsteries, laminates, paints and coatings, and carpeting to eliminate microbial growth.

Outlined below are two specific examples of the use of air cleaners for addressing IAQ problems. The air cleaners employed in these examples are described in greater detail in Attachment 8.

1. Total Particulate Control in an Office Complex

An office complex consisting of eleven wall offices with ten occupants, an open space area containing fifteen people and a conference room was sampled over a 7-hour period for total particulate levels. Sampling was done in a vacant, walled office ventilated by approximately 100 cfm of supply air from an HVAC system serving only this office complex. It is assumed that the

supply air to this office complex represents the particulate air quality (average) of the entire 5,000 square foot complex because there is no makeup (outside) air introduced by the HVAC system.

Particle counts (particles ≥ 0.3 micron) yielded an average of 728,181 particles per cubic foot. Eight air cleaners were placed in the office complex and the particle count repeated. The air cleaning units contained high efficiency particulate air (HEPA) filters with a minimum efficiency of 99.97 percent at 0.3 micron size particles. In total, 800 cubic feet of air was being cleaned and recirculated within the office complex each minute (approximately 32 cfm per occupant).

The average count over the seven hour period with the air cleaners in operation was 108,484 particles per cubic foot of air. This represents an 85.1-percent reduction in total particulate concentration in the office environment air.

2. Vapor Phase Smoke/Gaseous Contaminant Control

Four ceiling-mounted air cleaners were installed in a bingo hall to control both the visible smoke and the vapor phase components. The hall measured about 80 feet by 100 feet (with a 12-foot ceiling). Each air cleaner contained a 95 percent DOP (Military Standard 282) particulate filter and 60 pounds of activated carbon, and handled 1,000 cfm.

About one month after installation, the quantity of total ionizable gases was measured with and without the air cleaners in operation. With air cleaning, total ionizables were found to be 86 percent below the equilibrium established by the HVAC system alone. The visible smoke (particulate phase) also declined to the extent that it was no longer observable.

As promising as filtration/adsorption appear, it must be kept in mind that they are percentage mechanisms and therefore, cannot guarantee an explicit remediation value with variable beginning concentrations.

71. If you believe that OSHA should adopt the ASHRAE standards for controlling occupational exposures to indoor air contaminants, please provide any quantitative information you have to support their effectiveness in improving air quality. Please recommend what other actions should be taken.

The rising incidence of indoor air quality problems dates back to the early 1970s when indoor ventilation rates were significantly reduced in an effort to conserve energy. Numerous

studies over the past decade focused on this issue and have helped confirm the link between poor indoor air quality and low ventilation rates.

The ventilation rate of 20 cfm/person of outside air contained in ASHRAE standard 62-1989 is based on maintaining CO₂ levels at 800 ppm. It uses the level of CO₂ as an indicator of IAQ, and is designed to minimize the potential for adverse health effects. While not a perfect gauge, CO₂ is an effective indicator of human activity (see Figure 1 on page 45). A significant amount of data exist indicating that human activity is the principle cause of IAQ problems.⁴⁹

Preliminary research also indicates that biological contaminants such as viruses, bacteria and fungi are a major source of indoor air pollution and may cause thousands of deaths each year, mostly, although not exclusively, through respiratory diseases such as influenza and legionella. The only effective strategy for reducing biological contaminants, which cannot be controlled through traditional, source-specific approaches, is through provision of adequate indoor air ventilation and proper maintenance of ventilation systems.

Several of these studies are described in greater detail in Section IV above.

72. Please estimate what you believe the capital costs would be of incorporating the ASHRAE standard into your building's design and how doing so would affect the cost of renovation projects

The cost of complying with the ASHRAE standard will depend, in large part, on the building size and location. For a 36,000 square-foot building in Southern California (constructed in 1980) the cost associated with increasing the ventilation rate from 5 to 20 cfm/person was \$0.25 to \$0.30 per square foot per year. This cost was associated with cooling, and did not involve additional ducting/zoning cost or any control cost.

⁴⁹ Hodgson, A.T., J.M. Daisey, R.A. Grot, 1991, Sources and Source Strengths of Volatile Organic Compounds in a New Office Building, J. Air Waste Manage. Assoc. 41(11): 1461-1468.

- 73. How effective have modifications in ventilation systems and IAQ monitoring been in reducing the number of related illnesses and complaints in your workplace?**

Modifications in the ventilation system to increase ventilation efficiency and comprehensive IAQ monitoring does have a beneficial effect on complaint levels with facilities. For example, one BCIA member over the last 3 years has instituted a formal program to maintain the IAQ at its headquarters in the northeastern United States (see Attachment 9). The headquarters facility is a 1.2 million square foot office building with 2,358 private offices.

Part one of the program involved a complete rebalancing of the HVAC system to ensure that the ventilation rates recommended in ASHRAE 62-1989 were achieved. The second part involved relocating supply air dumps to prevent short cycling, thereby improving the ventilation efficiency in the work area. The third aspect is a maintenance program that keeps the HVAC system operating efficiently to provide properly conditioned air to the workspace with ASHRAE recommended amounts of filtered outside air. Part four involves a biannual inspection of the HVAC systems and measurements of IAQ contaminants providing a detailed "snapshot" of the IAQ, tracking changes in pollutant levels, and providing an independent assessment of the state of the building air quality.

Another very important aspect of the program is training key maintenance and engineering staff in indoor air quality diagnostics. Perhaps the most critical part of the program, however, is a formal procedure to investigate and mitigate IAQ complaints. Each complaint is taken seriously and thoroughly investigated. There also is a follow-up examination of the complaint area during the bi-annual inspection. Communication to building occupants of the IAQ program is also performed on a regular basis via newsletter, seminars, and individual consultations.

Anecdotal evidence in the facility demonstrates a positive response to the program, especially when details of the program have been communicated to occupants.

- 74. (a) Do you have a comprehensive program of regular HVAC system inspection and maintenance? (b) What does the program consist of?**

The building-systems approach to indoor air quality calls for a rigorous program of HVAC system maintenance, inspection and operator training. This program must be adhered to, and

reevaluated as necessary, throughout the entire life of the building. The first level of this program is system maintenance, as outlined in our response to question 15.

Regular inspection of the HVAC system is necessary to verify that the maintenance program is serving its intended purpose, and will further reveal any potential problems before they are likely to present a health hazard. Inspections should focus on internal chambers of each air handling unit, coils and drain pans, internal insulation of the air handling chambers and the main air supply duct, and humidifying equipment. They also should confirm that schedules for filter changes and calibrations of HVAC controls are being met.

Periodic reviews of the overall use and design of the building are also recommended, in order to ensure that the HVAC system is still fundamentally compatible with the building for which it was designed. Such a review should confirm that:

- (1) there is provision for exhaust from known indoor pollution sources such as photocopiers and cooking ovens;
- (2) the projected occupant activity, density and locations conform with design upon which the HVAC design was based;
- (3) there are no major outdoor sources of pollutants in the vicinity of the building site; and
- (4) office partitions are configured in a manner compatible with the design of the HVAC system.

Design intent and performance of all installed building systems require the development of suitable commissioning guidelines. These guidelines evolve during the design phase of a project to establish the intended HVAC system performance and the method for demonstrating such performance prior to the system's acceptance. Accordingly, it is recommended that any construction project use the appropriate ASHRAE consensus documents (Standard 55-1981 and ASHRAE Guideline 1-1989) to:

- o Establish suitable criteria to be used in the design of all affected building systems (interiors, material finishes and HVAC);
- o Provide a complete description of the HVAC system selected and its intended controls, operation and maintenance (refer to Attachment 10, Table 1);
- o Develop a commissioning plan, including a complete description and documentation of the work to be performed during construction (refer to Attachment 10, Figure 1);
- o Develop verification procedures for any tests and demonstrations to be performed, including evaluations

of ventilation rates, air filtration systems, and IAQ;

- o Establish a complete list of documentation of submittals required at the completion of commissioning (refer to Attachment 10, Figure 2);
- o Employ these documentation submittals as educational tools for operator training of the building owner's personnel.
- o Periodically conduct an audit of building operations and maintain a record of the findings for periodic owner/operator review.

Commissioning of HVAC systems is an integral part of maintaining acceptable IAQ. Its importance becomes apparent when a properly designed and installed system fails to live up to its expected performance in accordance with the design intent. Without proper planning and documentation through the progress of construction, one may have difficulty determining the design intent. Therefore, the designer must document the design intent in a more narrative and intelligible format and make it available in key stages of the construction process to the architects, owners, contractors, commissioning authority, and adequately trained in-house operation and maintenance personnel to ensure that equipment is properly maintained and operated.

Training of building operators represents one of the most important benefits of the commissioning process. BCIA believes that adequate training of stationary engineers is an important factor in maintaining and operating HVAC systems, and believes that indoor air quality issues should be included in the curricula for stationary engineers. The commissioning authority has direct responsibility in planning to train building operators and, consequently, must understand the overall HVAC system design and have the ability to diagnose possible performance problems and suggest potential solutions. Having early prepared documentation is essential not only to provide the operator with information needed to handle day-to-day problems following initial start-up but also to help him get familiar with system operations through hands-on training.

86. (a) In your local area how many establishments have voluntarily established indoor air policies? (b) What do these policies entail? (c) Do these policies vary between types of businesses? (d) Why were these policies adopted?

BCIA has no information regarding the establishment of indoor air policies in individual establishments. To our knowledge, indoor air quality policies are most commonly established on a municipal or state-wide basis. In this regard, the incorporation of ASHRAE 62-1989 into national building codes promises the most widespread implementation of comprehensive indoor air "policies" on the state and local level.

Last year, the Southern Building Code Congress International (SBCCI) adopted the ASHRAE ventilation standard by reference into its 1991 Standard Building Code. The SBCCI code is typically adopted as a whole by over 2,000 cities and local entities from Delaware to Oklahoma. Of the other two major national model building code organizations, the International Conference of Building Officials (ICBO) and the Building Officials and Code Administrators (BOCA), ICBO is considering incorporating all or part of the ASHRAE standard into a 1991 supplement to the code, and BOCA will consider reference to ASHRAE 62-1989 when it revises its code in 1993.

Also, at least five states (Connecticut, Massachusetts, Missouri, New Jersey, and Oregon) are currently considering legislation that would establish minimum ventilation standards for certain categories of public and commercial buildings, usually by referencing ASHRAE Standard 62-1989. In addition, the state of Washington has implemented a ventilation standards program.

92. If OSHA determines, on the basis of adequate evidence, that regulatory action is needed to protect employees from adverse health effects related to indoor air quality, what elements do you believe such regulation should include? Please provide the basis for your suggested element(s)?

BCIA's response to this question is provided in Section II.

Worked w/ Paul Cam on lots of
issues. Their position does make
sense. Need to deal w/ bldg systems.
They have ideas re: programs to
be implemented on bldg base. They
are pushing b/c they represent
chemical manufacturers. Bldg system
approach makes sense. ~~no~~ No
increasing. They Relief Reg
requirements imposed by OSHA, is
the way to go. Reel Estate and
Bldg management diff. Buildings are
not the only problem. Try to
reduce the emission and take
care of bldg systems. Canner.
Bldg systems approach

Osha has reverted to
200 re: indoor air and tobacco.
They are inclined to move
ahead w/ tobacco, but not
inclined to move ahead on
indoor air quality. There is
no regulatory scheme yet in
consideration. It would be
early to do enforcement if there
is a statute. Must be a

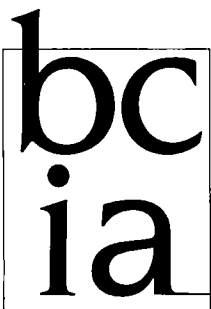
showing that there is an effect
that is linked to the sickness.

Whole new line for the
Gov't to get

EPA is out in front on the bldg guidance that builders follow. BCIA wants to have this become codified.

A lot of indoor air bills pending. The admin supported then Sen. Mitchell, it expands the non regulatory nature of the present EPA strategy. Bill was introduced in 1987.

— Companion Bill in the House. 3 Committee (Congressman Whelan) may have introduced a bill to do the same.



BUSINESS COUNCIL ON INDOOR AIR

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Weyerhaeuser Corporation

FAX

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Office of Air and Radiation (6203-J)
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington DC 20460
Phone: (202) 233-9030
FAX: (202) 233-9555

DATE: 8/1/93
TO: BRIAN BURKE 202 456-7028
FROM: Bob Axelrad
(202) 233-9315
SUBJECT: INDOOR AIR BILLS

2 Pages(s) to follow

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

NOTE:
 PRI-MARK-UP
 BILL CHANGES NOW
 BEING INTEGRATED

S. 656 "INDOOR AIR QUALITY ACT OF 1993"

Sponsors: Mitchell (D-ME), Chafee (R-RI), Lautenberg (D-NJ)

Major Provisions

- Requires numerous IAQ research and risk management activities:
 - Federal and private research
 - Management practices guidance/training
 - Assessment of and recommendations for ventilation standards
 - Contaminant health advisories
 - A national IAQ response plan
 - A Federal and other building demonstration programs
 - A State grant program
 - An IAQ Clearinghouse
- Raises IAD to the Office of Indoor Air
- Creates and staffs a Council on IAQ similar to the CIAQ
- Authorizes appropriation of \$48,500,00 for each fiscal year 94-98
- This bill is identical to the bill passed in the last two sessions of Congress

EPA Requirements

- Establish a national research, development, and demonstration program. (§5)
 - Conduct research, development, and demonstration activities and collect and make available results (§5(a)(2))
 - Fund research, development, and demonstration activities of state/local governments and nonprofit institutions (§5(a)(2) & §5(c)(4))
 - Study areas required: epidemiological, clinical, and lab studies on health effects, including MCS and other pollutant combination effects; exposures; high risk populations; building factors; sources; ambient/indoor relationships; contaminant fate; school and child-care facility considerations; sampling/control technologies; alternative materials; indoor foliage (§5(b))
 - Publish solicitation for proposals to demonstrate control technologies within 180 days after enactment of this Act, and at least every 12 months after (§5(c)(4))
 - Funding shall not exceed 75% of the total cost of the project (§5(c)(11))
 - Publish general reports for the public (when appropriate) (§5(c)(12))
 - Assess schools and child care facilities and report recommendations to Congress (within 2 yrs.) (§5(d))
 - Report to Congress on chemical sensitivity, including MCS (within 2 yrs.) (§5(e)(1))
 - Report to Congress on use of indoor foliage for indoor pollutant reduction, in consultation with NASA (within 2 yrs.) (§5(e)(2))
- Assess management practices and publish bulletins. Assess technologies and management practices for IAQ control/measurement and publish bulletins containing a description of the measure and an assessment of the effectiveness, feasibility of application, cost, and associated risks (§6(a))
 - EPA must allow public review and comment before publication of bulletins (§6(a)(5))
- Provide consulting for NIOSH in developing training. Provide consulting for NIOSH in developing training regarding model building management practices (within 24 mos.) (§6(b))
- Conduct a ventilation program. Analyze existing standards and their use and make recommendations concerning new standards and enforcement in a report to Congress (within 3 yrs.) (§6(c))

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"H.R. 1930 IAQ Act of 1993" (continued)

- **Healthy Buildings Baseline Study.** Conduct research with NIOSH on indoor air quality in nonresidential, nonindustrial buildings that comply with generally principles of proper design, maintenance, and operation of ventilation. (§5(h))
 - Study shall include: monitoring of biological contaminants, respirable particulate matter, volatile compounds, and other contaminants of interest; and to the maximum extent possible, the sources of the contaminants.
- **Assess management practices and publish bulletins.** Assess technologies and management practices for IAQ control/measurement and publish bulletins containing a description of the measure and an assessment of the effectiveness, feasibility of application, and cost. (§6)
 - Publish health advisories when a bulletin is issued that addresses a specific contaminant (§6(a)(4))
 - EPA must allow public review and comment before publication of bulletins (§6(a)(5))
- **Provide consulting for NIOSH in developing training.** Provide consulting for NIOSH in developing training regarding model indoor air quality course (within 12 months). (§6(b))
- **Contaminant Health Advisories.** Publish advisory materials addressing the health effects of indoor air contaminants that are likely to have adverse human health effects at higher concentrations. (§6(c))
 - At a minimum, advisories must: (§6(c)(1))
 - describe the physical, chemical, biological, and radiological properties of the contaminant
 - evaluate the adverse human effects of exposure to various concentrations of contaminants
 - describe any IAQ standards or related actions established under Federal, State, local, or foreign law
 - include information on the risk to sensitive subpopulations
 - characterize the likely sources of exposure
 - describe the contribution of ambient sources of the contaminant
 - refer to relevant technology or management practice bulletins
 - include relevant information from research conducted on human exposure
 - Establish a standard format for presentation of these health advisories (§6(c)(3))
 - Publish advisories (6 within 18mos., 6 more within 36 mos.) (§6(c)(4))
 - Allow public review and comment in the development and revision of these advisories (§6(c)(5))

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

H.R. 1930 "INDOOR AIR QUALITY ACT OF 1993"

Sponsor: Kennedy (D-MA)

Major Provisions

- Requires numerous IAQ research activities:
 - Federal research
 - Technology demonstration program
 - Model IAQ training course
 - Contaminant health advisories
 - IAQ Clearinghouse
 - Assessment of ventilation standards and guidelines
 - A national response strategy
 - Assessment of IAQ and corrective actions
 - State grants
- EPA shall not be considered to be exercising statutory authority to prescribe or enforce standards or regulations affecting occupational safety and health
- Authorizes appropriation of \$47,000,000 for each fiscal year 94-98
- Does not preempt more stringent laws

EPA Requirements

- Establish a national research, development, and demonstration program. (§5)
 - Conduct, assist, or facilitate research, investigations, surveys, or demonstrations (§5(b))
 - Study areas required: human exposure to indoor air contaminants; principal sources of harmful exposure; additive, cumulative, and synergistic effects of indoor air contaminants on sensitive populations, with emphasis on contaminants that comprise the greatest human exposure; methods for predicting exposure; improved techniques and equipment for assessing human exposure to contaminants; and techniques for improving indoor air quality, with emphasis on pollution prevention (§5(b))
- Establish a technology demonstration program to reduce exposure to indoor air contaminants. (§5(c)(1))
 - Give priority to activities that demonstrate feasibility and cost effectiveness (§5(c)(2))
 - Publish solicitation for proposals within 180 days after enactment of this Act, and at least every 12 months after (§5(c)(3))
 - Provide funding in excess of 75% of the total costs of the project in cases where it is determined that the research is basic or if the applicant is a local educational agency (§5(c)(4))
 - Publish general reports for the public (when appropriate) (§5(c)(5))
 - Consider indoor human exposure in the development of ambient air quality standards as required under the Clean Air Act (§5(d))
- Assess nationally the extent of indoor air contamination in buildings owned by local educational agencies and child care facilities. (§5(e))
 - Establish an advisory group (members not specified) to provide recommendations to the Administrator
- Indoor Allergens. Enter into agreements with the National Academy of Sciences to: (§5(f) & (g))
 - Conduct a study to review and assess issues related to chemical sensitivity disorders
 - Report to Congress on chemical sensitivity disorders
 - Conduct a study on indoor allergens

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"S. 656 IAQ Act of 1993" (continued)

• Authorization Section Titles:

Section 5	Indoor Air Quality Research
Section 6	Management Practices and Ventilation Standards
Section 7	Indoor Air Contaminant Health Advisories
Section 8	National Indoor Air Quality Response Plan
Section 9	Federal Building Response Plan and Demonstration Program
Section 10	State and Local Indoor Air Quality Programs
Section 11	Office of Indoor Air Quality
Section 12	Council on Indoor Air Quality
Section 13	Indoor Air Quality Information Clearinghouse
Section 14	Building Assessment Demonstration
Section 15	State and Federal Authority
Section 16	Authorizations

• Authorizations

-	For fiscal years ending September 30, 1994, 1995, 1996, 1997, and 1998, the following monies are authorized per year:	
-	Sections 5, 6, and 7 -	\$20,000,000
	Technology Demonstration Program (§5(c)) -	\$5,000,000
	Model Building Management Practices Training (§6(b)) -	\$1,000,000
	Indoor Air Contaminant Advisories (§7) -	\$5,000,000
	Remaining Tasks -	\$9,000,000
-	Sections 8, 9, 11, and 13 -	\$10,000,000
	Federal Building Response Plan and Demonstration Program (§9) -	\$2,000,000
	Indoor Air Quality Information Clearinghouse (§13) -	2,000,000
	Remaining Tasks -	\$8,000,000
-	Section 10 -	\$12,000,000
	Response Programs (§10(b)) -	\$4,000,000
	Remaining Tasks -	\$8,000,000
-	Section 12 -	\$1,500,00
	Council on Indoor Air Quality (§12) -	\$1,500,00
-	Section 14 -	\$5,000,000
	Building Assessment Demonstration (§14) -	\$5,000,000

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"S. 656 IAQ Act of 1993" (continued)

- **State Grants.** Provide funding to State IAQ Programs: (§10)
 - Development and implementation of IAQ management strategies (grants are to be at least \$75,000)
 - Development and implementation of IAQ assessment (grants are to be at least \$75,000)
 - Response programs (grants cannot be more than \$250,000)
- **Office of Indoor Air.** Establish an Office of Indoor Air within ORIA (§11)
- **Council on Indoor Air Quality** (§12)
 - Chair the CIAQ for two years (§12(c)(2))
 - Contribute to a Report to Congress (within 18 mos. and then biennially) covering: (§12(d))
 - problem assessment
 - research agenda and issues
 - activities undertaken and planned
 - recommendations
- **IAQ Clearinghouse.** Establish a clearinghouse. (§13)
 - Disseminate information to government and private sectors (§13(a)(1))
 - Repository of information required under this Act (§13(a)(2))
 - Operate a hotline (§13(a)(3))
 - May implement through a contractual agreement with a non-profit organization (§13(a)(4))
- **Building Assessment.** Provide consulting for NIOSH in an assessment demonstration program for developing protocols for assessing contamination in buildings (§14)

Summary of Reports to Congress.

- MCS (within 2 years)
- Indoor Foliage (within 2 years)
- Ventilation Program (within 2 years)
- Council on IAQ Report (within 18 months, then biennially)

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"S. 656 IAQ Act of 1993" (continued)

- **Contaminant Health Advisories. (§7)**
 - Publish a list of indoor air contaminants and mixtures expected to cause health effects (within 240 days). Update the list biennially. The list must include: benzene, biological contaminants, carbon monoxide, formaldehyde, lead, methylene chloride, nitrogen oxide, particulate matter, asbestos, PAHs, and radon. [While eleven contaminants make up the minimum list, at least 12 health advisories are required within 36 mos.]
 - Publish health advisories for each listed contaminant describing health effects, risk, sources, standards (6 within 18 mos., 6 more within 36 mos.). Review and revise advisories at least every 5 yrs.

- **National IAQ Response Plan. Develop and publish, in coordination with other Federal agencies, a plan to reduce exposures to indoor air contaminants listed under contaminant health advisories. (within 24 mos. and then biennially) (§8)**
 - Use existing statutory authority (§8(b))
 - Develop public outreach including: (§8(c))
 - exposure reduction guidance that describes costs and feasibility
 - guidance
 - education
 - training
 - Develop model building codes, including ventilation rates (§8(c))
 - Identify contaminants or circumstances for which (§8(c)):
 - immediate action is necessary to protect public and worker health and describe actions needed
 - existing statutes are inadequate (recommend necessary legislation)
 - development of new technologies is required for reduction
 - Identify remedies to SBS (§8(d))
 - design and construction
 - O & M
 - standardized investigation protocol
 - Assess and certify IAQ Firms (§8(g))
 - assess monitoring and mitigation services
 - review and analyze options for oversight
 - EPA must allow for public review and comment

- **Federal Building Response Plan/Demonstration. Provide consulting to GSA on IAQ response plans for Federal buildings including recommendations for regulations establishing a method for confidential filing of IAQ complaints (plan within 24 mos.; biennially thereafter). (§9)**
 - Any new EPA headquarters shall be constructed, designed, and maintained as a model building for IAQ (§9(d))

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"H.R. 1930 IAQ Act of 1993" (continued)

● Authorization Section Titles:

Section 5	Indoor Air Quality Research, Development, and Demonstration
Section 6	Management Practices to Reduce Indoor Air Contamination
Section 7	National Indoor Air Quality Response Strategy
Section 8	Federal Building Evaluation and Remediation Program
Section 9	State and Local Indoor Air Quality Grant Program
Section 10	Relation to Other Law
Section 11	Reports
Section 12	Authorizations for Research and Related Activities

● Report to Congress. EPA shall submit to Congress a report on the activities that it performed (not later than 2 yrs.). The report shall include: (§11)

- Results of the national assessment (§11(a)(1))
- Results of the healthy building study (§11(a)(2))
- Assessment of the training program, including recommendations (§11(a)(3))
- Description of the ventilation program (§11(a)(4))
- Response strategy (§11(a)(5))
- Assessment of the Federal building evaluation and remediation program (§11(a)(6))

● Authorizations

- For fiscal years ending September 30, 1994, 1995, 1996, 1997, and 1998, the following monies are authorized per year:

Sections 5, 6(a), 6(b), and 6(c) -	\$25,000,000
Technology Demonstration Program (§5(c)) -	\$6,250,000
Indoor Air Contaminant Health Advisories (§6(c)) -	\$6,250,000
Remaining Tasks -	\$12,500,000
- Sections 6(d), 7, and 8 -

Indoor Air Quality Information Clearinghouse (§6(d)) -	\$10,000,000
Federal Building Evaluation and Remediation Program (§8) -	\$2,000,000
Remaining Tasks -	\$2,000,000
	\$6,000,000
- Section 9 -

Response Programs (§9(c)) -	\$12,000,000
Remaining Tasks -	\$4,000,000
	\$8,000,000

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"H.R. 1930 IAQ Act of 1993"
 (continued)

- **Federal Building Evaluation and Remediation Program.** Provide consulting to NIOSH in developing a Federal Building Evaluation and remediation program (within one year). (§8)
 - Develop a plan to evaluate a minimum of 20 Federal buildings (to be carried out by ORD) (§8(a)(5))
 - Coordinate with NIOSH to develop and disseminate to all Federal agencies a model indoor air quality remediation program including recommendations for regulations establishing a method for confidential filing of IAQ complaints (§8(b)(1))
 - Submit a plan to NIOSH addressing indoor air contamination in EPA buildings within one year of receipt of the model plan (§8(b)(2))
 - EPA must implement a systematic program for the receiving of complaints, assessing IAQ, and mitigating problems (within 3 yrs.) (§8(c))
 - Program must include method for the confidential filing of comments and complaints (§8(c)(2))
 - EPA must submit a copy of its program to NIOSH and confirm annually that it is adhering to its program (§8(c)(3))
 - When responsible for the design and construction of a building, EPA must employ up to date design, commissioning, and operating practices (§8(d)(1))
 - EPA must maintain files, with the Administrator and the IAQ Clearinghouse, of reports from other Federal agencies outlining activities undertaken (§8(d)(2))
 - Any new or renewal lease must guarantee that the building ventilation systems are operating correctly (§8(e))
 - EPA must designate (within one year) and train (within 4 yrs.) an Indoor Air Quality Coordinator and assistants for its agency (§8(f))
- **State and Local Grants.** Provide funding to State and Local IAQ Programs: (§9)
 - Development and implementation of IAQ management strategies (grants are to be at least \$75,000)
 - Development and implementation of IAQ assessment (grants are to be at least \$75,000)
 - Response programs (grants cannot be more than \$250,000)

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"H.R. 1930 IAQ Act of 1993"
(continued)

- **IAQ Clearinghouse.** Establish a clearinghouse. (§6(d))
 - Disseminate information to government and private sectors (§6(d)(1))
 - Repository of information required under this Act (§6(d)(2))
 - Operate a hotline (§6(d)(3))
 - May implement through a contractual agreement with a non-profit organization (§6(d)(4))
- **Ventilation Standards and Guidelines.** Analyze the adequacy of existing ventilation standards and guidelines. (§6(e))
 - Determine the effectiveness of existing standards (§6(e)(1))
 - Assess the costs and benefits of compliance (§6(e)(2)(A))
 - Evaluate the efficacy of increasing building ventilation rates (§6(e)(2)(B))
 - Assess the potential for ventilation to complement controls over specific sources of contaminants (§6(e)(2)(C))
- **Priority Listing.** Indoor air contaminants shall be reviewed for inclusion in TSCA's priority listing. (§6(g))
- **National IAQ Response Strategy.** Develop and publish, in coordination with other Federal agencies, a strategy to reduce exposures to indoor air contaminants. (§7)
 - Provide for implementation of range of response actions (§7(a)(2))
 - Use existing statutory authority (§7(b))
 - Develop public outreach (§7(c))
 - technical information distribution programs, including an indication of cost and feasibility
 - education programs
 - options (private and public sector) for providing technical assistance on IAQ topics
 - The first published strategy must: (§7(d))
 - evaluate indoor air quality diagnostic and mitigation services
 - evaluate IAQ/energy efficiency knowledge of ventilation system operators
 - assess potential of ventilation to complement controls over specific sources of contaminants
 - EPA must allow for public review and comment (§7(e))

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"H.R. 1930 IAQ Act of 1993"
 (continued)

- **Healthy Buildings Baseline Study.** Conduct research with NIOSH on indoor air quality in nonresidential, nonindustrial buildings that comply with generally principles of proper design, maintenance, and operation of ventilation. (§5(h))
 - Study shall include: monitoring of biological contaminants, respirable particulate matter, volatile compounds, and other contaminants of interest; and to the maximum extent possible, the sources of the contaminants.
- **Assess management practices and publish bulletins.** Assess technologies and management practices for IAQ control/measurement and publish bulletins containing a description of the measure and an assessment of the effectiveness, feasibility of application, and cost. (§6)
 - Publish health advisories when a bulletin is issued that addresses a specific contaminant (§6(a)(4))
 - EPA must allow public review and comment before publication of bulletins (§6(a)(5))
- **Provide consulting for NIOSH in developing training.** Provide consulting for NIOSH in developing training regarding model indoor air quality course (within 12 months). (§6(b))
- **Contaminant Health Advisories.** Publish advisory materials addressing the health effects of indoor air contaminants that are likely to have adverse human health effects at higher concentrations. (§6(c))
 - At a minimum, advisories must: (§6(c)(1))
 - describe the physical, chemical, biological, and radiological properties of the contaminant
 - evaluate the adverse human effects of exposure to various concentrations of contaminants
 - describe any IAQ standards or related actions established under Federal, State, local, or foreign law
 - include information on the risk to sensitive subpopulations
 - characterize the likely sources of exposure
 - describe the contribution of ambient sources of the contaminant
 - refer to relevant technology or management practice bulletins
 - include relevant information from research conducted on human exposure
 - Establish a standard format for presentation of these health advisories (§6(c)(3))
 - Publish advisories (6 within 18mos., 6 more within 36 mos.) (§6(c)(4))
 - Allow public review and comment in the development and revision of these advisories (§6(c)(5))

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION**H.R. 1930 "INDOOR AIR QUALITY ACT OF 1993"****Sponsor: Kennedy (D-MA)****Major Provisions****● Requires numerous IAQ research activities:**

- Federal research
- Technology demonstration program
- Model IAQ training course
- Contaminant health advisories
- IAQ Clearinghouse
- Assessment of ventilation standards and guidelines
- A national response strategy
- Assessment of IAQ and corrective actions
- State grants

● EPA shall not be considered to be exercising statutory authority to prescribe or enforce standards or regulations affecting occupational safety and health

● Authorizes appropriation of \$47,000,000 for each fiscal year 94-98

● Does not preempt more stringent laws

EPA Requirements**● Establish a national research, development, and demonstration program. (§5)**

- Conduct, assist, or facilitate research, investigations, surveys, or demonstrations (§5(b))
- Study areas required: human exposure to indoor air contaminants; principal sources of harmful exposure; additive, cumulative, and synergistic effects of indoor air contaminants on sensitive populations, with emphasis on contaminants that comprise the greatest human exposure; methods for predicting exposure; improved techniques and equipment for assessing human exposure to contaminants; and techniques for improving indoor air quality, with emphasis on pollution prevention (§5(b))

● Establish a technology demonstration program to reduce exposure to indoor air contaminants. (§5(c)(1))

- Give priority to activities that demonstrate feasibility and cost effectiveness (§5(c)(2))
- Publish solicitation for proposals within 180 days after enactment of this Act, and at least every 12 months after (§5(c)(3))
- Provide funding in excess of 75% of the total costs of the project in cases where it is determined that the research is basic or if the applicant is a local educational agency (§5(c)(4))
- Publish general reports for the public (when appropriate) (§5(c)(5))
- Consider indoor human exposure in the development of ambient air quality standards as required under the Clean Air Act (§5(d))

● Assess nationally the extent of indoor air contamination in buildings owned by local educational agencies and child care facilities. (§5(e))

- Establish an advisory group (members not specified) to provide recommendations to the Administrator

● Indoor Allergens. Enter into agreements with the National Academy of Sciences to: (§5(f) & (g))

- Conduct a study to review and assess issues related to chemical sensitivity disorders
- Report to Congress on chemical sensitivity disorders
- Conduct a study on indoor allergens

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"S. 656 IAQ Act of 1993" (continued)

• Authorization Section Titles:

Section 5	Indoor Air Quality Research
Section 6	Management Practices and Ventilation Standards
Section 7	Indoor Air Contaminant Health Advisories
Section 8	National Indoor Air Quality Response Plan
Section 9	Federal Building Response Plan and Demonstration Program
Section 10	State and Local Indoor Air Quality Programs
Section 11	Office of Indoor Air Quality
Section 12	Council on Indoor Air Quality
Section 13	Indoor Air Quality Information Clearinghouse
Section 14	Building Assessment Demonstration
Section 15	State and Federal Authority
Section 16	Authorizations

• Authorizations

-	For fiscal years ending September 30, 1994, 1995, 1996, 1997, and 1998, the following monies are authorized per year:	
-	Sections 5, 6, and 7 -	\$20,000,000
	Technology Demonstration Program (§5(c)) -	\$5,000,000
	Model Building Management Practices Training (§6(b)) -	\$1,000,000
	Indoor Air Contaminant Advisories (§7) -	\$5,000,000
	Remaining Tasks -	\$9,000,000
-	Sections 8, 9, 11, and 13 -	\$10,000,000
	Federal Building Response Plan and Demonstration Program (§9) -	\$2,000,000
	Indoor Air Quality Information Clearinghouse (§13) -	2,000,000
	Remaining Tasks -	\$8,000,000
-	Section 10 -	\$12,000,000
	Response Programs (§10(b)) -	\$4,000,000
	Remaining Tasks -	\$8,000,000
-	Section 12 -	\$1,500,00
	Council on Indoor Air Quality (§12) -	\$1,500,00
-	Section 14 -	\$5,000,000
	Building Assessment Demonstration (§14) -	\$5,000,000

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"S. 656 IAQ Act of 1993" (continued)

- **State Grants.** Provide funding to State IAQ Programs: (§10)
 - Development and implementation of IAQ management strategies (grants are to be at least \$75,000)
 - Development and implementation of IAQ assessment (grants are to be at least \$75,000)
 - Response programs (grants cannot be more than \$250,000)
- **Office of Indoor Air.** Establish an Office of Indoor Air within ORIA (§11)
- **Council on Indoor Air Quality** (§12)
 - Chair the CIAQ for two years (§12(c)(2))
 - Contribute to a Report to Congress (within 18 mos. and then biennially) covering: (§12(d))
 - problem assessment
 - research agenda and issues
 - activities undertaken and planned
 - recommendations
- **IAQ Clearinghouse.** Establish a clearinghouse. (§13)
 - Disseminate information to government and private sectors (§13(a)(1))
 - Repository of information required under this Act (§13(a)(2))
 - Operate a hotline (§13(a)(3))
 - May implement through a contractual agreement with a non-profit organization (§13(a)(4))
- **Building Assessment.** Provide consulting for NIOSH in an assessment demonstration program for developing protocols for assessing contamination in buildings (§14)

Summary of Reports to Congress.

- MCS (within 2 years)
- Indoor Foliage (within 2 years)
- Ventilation Program (within 2 years)
- Council on IAQ Report (within 18 months, then biennially)

INDOOR AIR QUALITY & ENVIRONMENTAL TOBACCO SMOKE LEGISLATION

"S. 656 IAQ Act of 1993" (continued)

- **Contaminant Health Advisories. (§7)**
 - Publish a list of indoor air contaminants and mixtures expected to cause health effects (within 240 days). Update the list biennially. The list must include benzene, biological contaminants, carbon monoxide, formaldehyde, lead, methylene chloride, nitrogen oxide, particulate matter, asbestos, PAHs, and radon. [While eleven contaminants make up the minimum list, at least 12 health advisories are required within 36 mos.]
 - Publish health advisories for each listed contaminant describing health effects, risk, sources, standards (6 within 18 mos., 6 more within 36 mos.). Review and revise advisories at least every 5 yrs.

- **National IAQ Response Plan. Develop and publish, in coordination with other Federal agencies, a plan to reduce exposures to indoor air contaminants listed under contaminant health advisories. (within 24 mos. and then biennially) (§8)**
 - Use existing statutory authority (§8(b))
 - Develop public outreach including: (§8(c))
 - exposure reduction guidance that describes costs and feasibility
 - guidance
 - education
 - training
 - Develop model building codes, including ventilation rates (§8(c))
 - Identify contaminants or circumstances for which (§8(c)):
 - immediate action is necessary to protect public and worker health and describe actions needed
 - existing statutes are inadequate (recommend necessary legislation)
 - development of new technologies is required for reduction
 - Identify remedies to SBS (§8(d))
 - design and construction
 - O & M
 - standardized investigation protocol
 - Assess and certify IAQ Firms (§8(g))
 - assess monitoring and mitigation services
 - review and analyze options for oversight
 - EPA must allow for public review and comment

- **Federal Building Response Plan/Demonstration. Provide consulting to GSA on IAQ response plans for Federal buildings including recommendations for regulations establishing a method for confidential filing of IAQ complaints (plan within 24 mos.; biennially thereafter). (§9)**
 - Any new EPA headquarters shall be constructed, designed, and maintained as a model building for IAQ (§9(d))

Brian Burke -
give me a buzz

after
you
glance
at
this.
CH

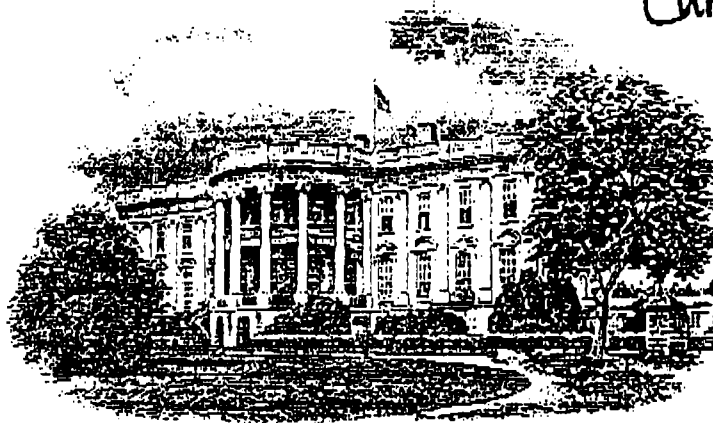
OFFICE ON ENVIRONMENTAL POLICY

TO: Chuck Fox
FROM: Christian Marsh / Cathy Zoi
DATE: July 9, 1993
FAX: cc: Carol Rasco

Number of pages including cover: 3

COMMENTS: Cathy would like to set up a meeting
between the BCIA, you, Axelrod, and
any others you suggest. Zoi would attend and
I can schedule. I will contact
you to set this up.

Thanks,
Christian



PHONE - (202) 456-6224 FAX - (202) 456-2710
ROOM 360 OLD EXECUTIVE OFFICE BUILDING
WASHINGTON, DC 20501



BUSINESS COUNCIL ON INDOOR AIR

1025 Connecticut Avenue, N.W. Suite 712, Washington, D.C. 20036 ☐ (202) 775-5887

Fax: (202) 223-5979

June 3, 1993

Ms. Katie McGinty
Special Assistant to the President
for Environment
The White House
1600 Pennsylvania Avenue, NW
Washington, D.C. 20500

Dear Ms. McGinty:

Earlier this year, I wrote to you asking for a brief meeting to discuss the Administration's views on indoor air issues. Your staff informed me that your calendar was full and that I should check again in a couple of months. I am hoping that sufficient time has elapsed such that you can find the opportunity to discuss with us any of the following items: (1) legislative initiatives in the House and Senate; (2) interagency coordination of indoor air research; and (3) status of rulemaking efforts at OSHA.

Perhaps the most opportune time for this informal discussion would be at the August 3 meeting of BCIA's Board of Directors. The meeting will be in Washington, and you can choose any time that is convenient to you between 10:30 a.m. and 1:30 p.m. Business representatives from the following companies or organizations will be attending:

Air Products & Chemicals, Inc.
Allied Signal Inc.
Carpet & Rug Institute
Dow Chemical Company
Eastman Chemical Company
Healthy Buildings International

Honeywell, Inc.
Manville Corporation
Meckler Group (Consulting Engineers)
National Particleboard Association
Owens Corning Fiberglas
Union Carbide Corporation

If you are not available on August 3, we are still interested in visiting you in your office for a brief exchange on the subjects listed above. Please let me know what is best for you.

Carl Wed.

Sincerely,

Paul A. Cammer, Ph.D.
President

*Christians
hurt - ~~harm~~ I can broker a mtg.
① Fax these mat'ls to Chuck Fox. Ask him
to bring Axelrad and anyone else
② mark my calendar
③ Drop a note to Rose
- CS #12*

*Calvin
These guys are
getting difficult
can we meet with?
- Chris
Do we get involved??
Can some
else meet
with.*

*Margie
OGE*



BUSINESS COUNCIL ON INDOOR AIR

1025 Connecticut Avenue, N.W. Suite 712, Washington, D.C. 20036 ☐ (202) 775-5887

April 2, 1993

Fax: (202) 223-5979

Ms. Katie McGinty
Special Assistant to the President
for Environment
The White House
1600 Pennsylvania Avenue, N.W.
Washington, D.C. 20500

Dear Ms. McGinty:

Several weeks ago we sent the enclosed letter to Carol Rasco seeking a meeting to discuss the Administration's policy on indoor air. I understand from her office that you have agreed to meet with us in the near future.

As we have not yet heard from you, I am taking this opportunity to reaffirm our interest in this meeting. The Senate has just introduced indoor air legislation identical to the package it approved last year, and Congressman Joseph Kennedy is expected to introduce comprehensive legislation this week on the same subject. Consequently, we would like to meet with you as soon as possible in anticipation of the likely Congressional hearings. In addition, there are a number of non-legislative activities on indoor air that are of great interest to us, notably the possibility of a general indoor air rulemaking at OSHA.

I will call you early next week so that we can arrange a mutually agreeable time to meet.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Paul A. Cammer', with a long horizontal stroke extending to the right.

Paul A. Cammer, Ph.D.
President

Enclosure



Department of Energy
Washington, DC 20585

**OFFICE OF THE EXECUTIVE SECRETARIAT
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f
Date: 9/9/93

To: William Burke

a
From: Sec. O'Leary

Transmittal consists of 9 pages, excluding this form.

X
Notes:



The Secretary of Energy
Washington, DC 20585

September 9, 1993

MEMORANDUM FOR MACK MCLARTY, THE WHITE HOUSE

FROM: HAZEL R. O'LEARY

SUBJECT: Weekly Report

A handwritten signature in dark ink, appearing to read "Hazel R. O'Leary", is written over the typed name and extends to the right.

KEY DEPARTMENT NEWS

• **Hanford Economic Development Summit**

Washington Governor Mike Lowry and I will co-chair an economic development summit at Hanford, Washington, September 14 and 15. Hanford was the Department's largest weapons production facility, and now is the most challenging site to clean up. We estimate that site clean up will cost \$60 billion.

The summit will chart a course toward a more diversified post Cold War economy in Washington and Oregon and will help stimulate more effective and efficient responses to Hanford's serious environmental and safety problems. The summit will address issues such as:

- The local economy after clean up;
- Worker health and safety; and
- Support for hazardous materials management and emergency response.

The agenda includes:

- Meeting with local stakeholders, including State officials, facility employees, business leaders, Native American groups and environmental organizations;
- Announcing the Department's Safety Initiative;
- Touring the environmental remediation facilities;
- Participating in a Contract Reform Public Stakeholder meeting; and
- Participating in several regional media events including a live segment with K-PER TV, Washington, an editorial board with *Tri-City Herald* and an interview with the Associated Press.

• **Contract Reform Initiative**

Both Deputy Secretary Bill White and I will hold press events next week to highlight the Department's Contract Reform Initiative. The Department, which contracts more work than any other Federal agency, faces a lack of contractor accountability that results in wasteful spending and inadequate program execution. The goal of this initiative is to examine the Department's current contractual policies and create new policies that provide better services at reduced cost.

On September 15, while at the Hanford Summit, I will talk to the press about the Department's initiative to improve its contractual policy. Deputy Secretary White will hold two press events: September 14 in Washington, D.C., for national media and September 15, in Idaho Falls, Idaho.



The purpose of these media events is not only to bring attention to the Department's on-going Contract Reform Initiative but also to promote our efforts in defense of a *60 Minutes* program scheduled to air on September 26 which will portray the Department's contract policy unfavorably.

- Limited Radioactive Contamination at Los Alamos National Laboratory

Monday, August 30, four workers at the Department's Los Alamos National Laboratory in New Mexico inhaled very small quantities of plutonium fluoride when an accidental leak occurred. Each employee received small amounts of exposure.

DOE Headquarters was not promptly notified despite explicit reporting requirements. The Assistant Secretary for Defense Programs traveled to Los Alamos as soon as Headquarters was notified of the incident. During his visit he spoke with three of the four exposed workers and with Laboratory management to discuss how such health risks can be avoided in the future and how communication and emergency response can be improved in the event of such an accident.

- National Association of State Energy Officials

Senator Jeff Bingaman (D-NM) and I are scheduled to deliver the keynote addresses at the annual meeting of the National Association of State Energy Officials on September 13. My address will focus on the Administration's initiatives in energy efficient technologies, climate change and the Clean Cities Initiative. Approximately 150 state energy officials will attend. Regional press coverage is anticipated.

CONGRESS

- Outreach Meetings

This week I met with Congresswoman Blanche Lambert (D-AR) and Congressman Billy Tauzin (D-LA) to discuss Administration initiatives and specific departmental site concerns.

- Mark-ups and Floor Actions

The Senate is expected to consider the Defense Authorization Act this week. This bill authorizes many of the Department's programs. There does not appear to be any substantial obstacles to passage of this legislation.

The Senate is expected to consider the FY 94 Department of Interior and Related Agencies Appropriations Act (H.R. 2520) following the passage of the FY 94 National Defense Authorization Act (S. 1298) next week.

The Appropriations Subcommittee on Energy and Water Development is expected to mark up its FY 94 Energy and Water Development Appropriations Act (H.R. 2445). This legislation contains funding for 90 percent of the Department's programs, including defense, environmental cleanup and a majority of the civilian programs.

- Hearings

Wednesday, September 15, Tara O'Toole, Assistant Secretary for Environment, Safety and Health designate, and Jay Hakes, Administrator for Energy Information Administration designate, will appear before the Senate Energy and Natural Resources Committee for confirmation.

As we discussed, I have met with virtually every member of the committee and am more confident that Dr. O'Toole's confirmation hearing will not be controversial.

PRESS

- National Performance Review

Following Tuesday's National Performance Review unveiling, I participated in a series of press interviews to discuss this important Administration initiative. Tuesday and Wednesday, I conducted radio interviews with five Minnesota radio stations and spoke with reporters from the *Energy Daily* and the following Idaho newspapers:

- *The Idaho Statesman*
- *The Post Register*
- *The Lewiston Tribune*
- *The Twin Falls Times-News*

- National Electrical Manufacturers Association

I addressed the Board of the National Electrical Manufacturers Association (NEMA). My remarks focused on the Department's Energy Efficiency Initiative and the Administration's global climate change initiative. The Department has worked to develop a voluntary initiative with NEMA to market and commercialize energy-efficient motors.

- Media Round Table

Today I am participating in a round table discussion with DeWayne Wicham, of *USA Today*, Gannett, Clarence Page of the *Chicago Tribune*, Allegra Bennett of the *Washington Times* and Ed Gordon, anchor for Black Entertainment Television's *Lead Story* program. The topic of discussion will be my role in the Administration.

- Greater Erie Community Action Committee Address

Friday, September 10, I will address an audience of 400 at the Greater Erie Community Action Committee's 23rd annual dinner. The topics of my address will include energy efficiency, economic development, NAFTA, and reinventing government. Regional media coverage is expected.

- Americans for Energy Independence Address

Tomorrow I will address an audience of approximately 80 members of Americans for Energy Independence. The focus of my address will be the Department's efforts to reconcile the interests of energy producers with those of the environmental community. I will also discuss the Department's Domestic Energy and Energy Efficiency Initiatives.

- Deputy Secretary White's Speaking Engagements

Friday, September 10, Deputy Secretary White will address the 12th Annual Energy Impact Conference sponsored by the Corpus Christi, Texas, Chamber of Commerce. The Department's ongoing domestic natural gas and oil initiative, NAFTA and reinventing government will be the focus of his remarks.

FRIDAY, SEPTEMBER 10, 1993

SCHEDULE FOR HAZEL R. O'LEARY

8:00 AM DEPART RESIDENCE FOR THE UNIVERSITY CLUB
Met by Reggie Sellers

8:30 AM - 9:30 AM Address the American for Energy Independence
Board of Directors
The University Club
1135 16th Street, N.W.

9:45 AM DEPART THE UNIVERSITY CLUB FOR DOE
Met by Reggie Sellers

10:00 AM - 11:30 AM Allen Weinstein
(Rich Rosenzweig)

11:30 AM - 12:30 PM Strategy Briefing
(Bill White, Sue Tierney, Rich Rosenzweig,
Dirk Forrister, Dan Reicher, Kyle Simpson,
Mike Gauldin)

12:30 PM - 1:30 PM Lunch
(Rich Rosenzweig, Mike Gauldin)

2:00 PM DEPART DOE FOR WASHINGTON NATIONAL AIRPORT
Met by Reggie Sellers

2:30 PM TRAVEL - Erie, Pennsylvania

5:00 PM Speak - Greater Erie Community Action
Committee's 23rd Annual Dinner

MONDAY, SEPTEMBER 13, 1993

SCHEDULE FOR HAZEL R. O'LEARY

1:45 PM

**Speak - National Association of State
Energy Officials Annual Meeting**

TUESDAY, SEPTEMBER 14, 1993
SCHEDULE FOR HAZEL R. O'LEARY

Travel - Washington State

WEDNESDAY, SEPTEMBER 15, 1993
SCHEDULE FOR HAZEL R. O'LEARY

THURSDAY, SEPTEMBER 16, 1993
SCHEDULE FOR HAZEL R. O'LEARY

12:00 PM - 5:00 PM HOLD

FRIDAY, SEPTEMBER 17, 1993

SCHEDULE FOR HAZEL R. O'LEARY

7:30 AM	DEPART RESIDENCE FOR DOE Met by Reggie Sellers
8:00 AM - 8:30 AM	Beth, Carolyn, Johannah, LaWanna
11:00 AM - 12:00 PM	Minority Business Summit Panel Congressman Kweisi Mfume (D-MD)
12:30 PM	Congressional Black Caucus Luncheon
3:00 PM	Briefing for the U.S. DOE/DOC Electric Power Mission to China with Secretary Brown (Jack Siegel)
6:30 PM	DEPART DOE

United States
Environmental Protection
Agency
Washington, DC 20460

July 1993
402-F-93-004

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SECONDHAND SMOKE

What You Can Do About Secondhand Smoke

As Parents,  Decisionmakers,

and  Building Occupants



What Is Secondhand Smoke?

WHAT IS SECONDHAND SMOKE?

- Secondhand smoke is a mixture of the smoke given off by the burning end of a cigarette, pipe, or cigar, and the smoke exhaled from the lungs of smokers.

- This mixture contains more than 4,000 substances, more than 40 of which are known to cause cancer in humans or animals and many of which are strong irritants.

- Secondhand smoke is also called environmental tobacco smoke (ETS); exposure to secondhand smoke is called involuntary smoking, or passive smoking.

SECONDHAND SMOKE CAN CAUSE LUNG CANCER IN NONSMOKERS

- Secondhand smoke has been classified by the U.S. Environmental Protection Agency (EPA) as a known cause of lung cancer in humans (Group A carcinogen).
- Passive smoking is estimated by EPA to cause approximately 3,000 lung cancer deaths in nonsmokers each year.

SECONDHAND SMOKE IS A SERIOUS HEALTH RISK TO CHILDREN

- The developing lungs of young children are also affected by exposure to secondhand smoke.

- Infants and young children whose parents smoke are among the most seriously affected by exposure to secondhand smoke, being at increased risk of lower respiratory tract infections such as pneumonia and bronchitis. EPA estimates that passive smoking is responsible for between 150,000 and 300,000 lower respiratory tract infections in infants and children under 18 months of age annually, resulting in between 7,500 and 15,000 hospitalizations each year.

- Children exposed to secondhand smoke are also more likely to have reduced lung function and symptoms of respiratory irritation like cough, excess phlegm, and wheeze.

- Passive smoking can lead to a buildup of fluid in the middle

ear, the most common cause of hospitalization of children for an operation.

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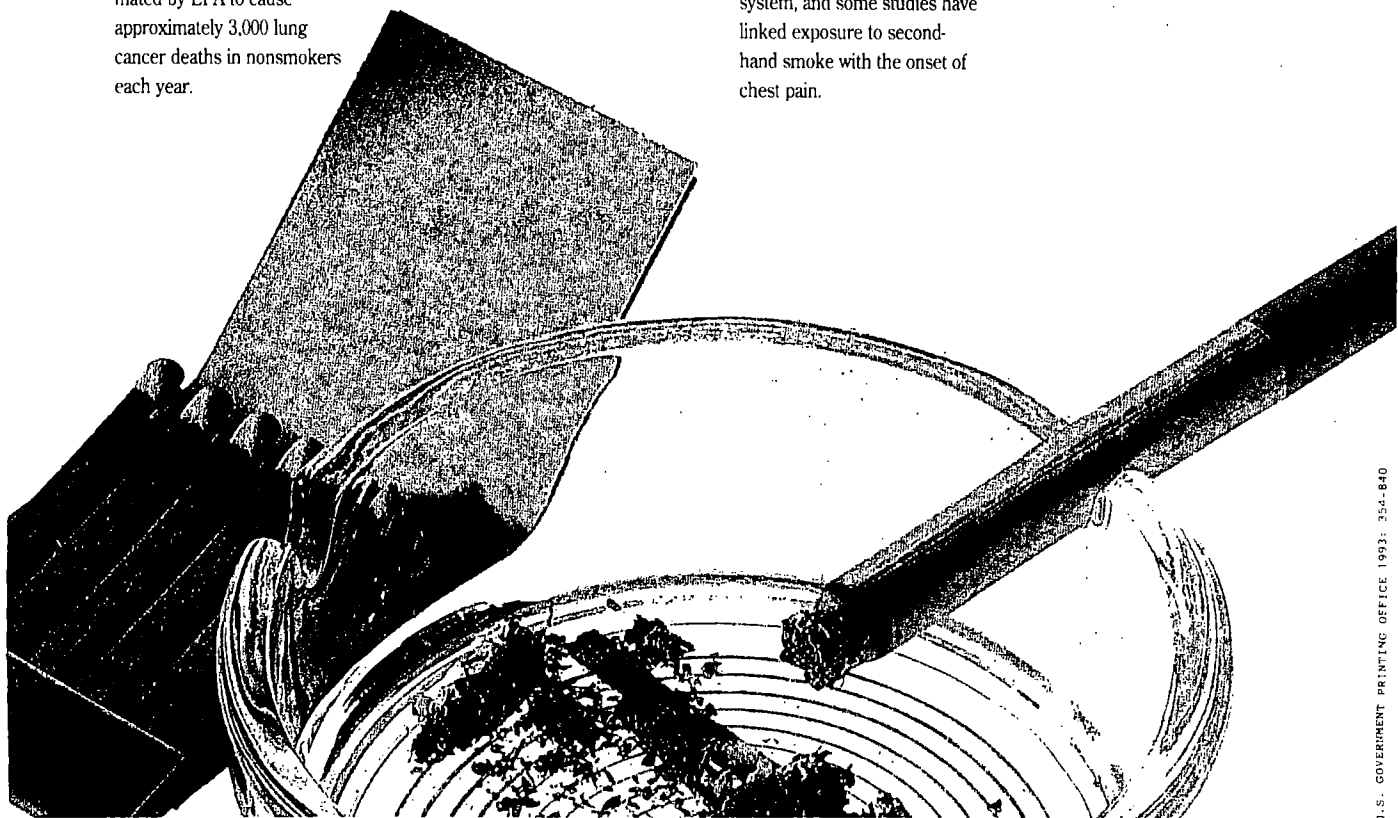
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- If your company does not have a smoking policy that effectively controls secondhand smoke, work with appropriate management and labor organizations to establish one.
- Simply separating smokers and nonsmokers within the same area, such as a cafeteria, may reduce exposure, but nonsmokers will still be exposed to recirculated smoke or smoke drifting into nonsmoking areas.
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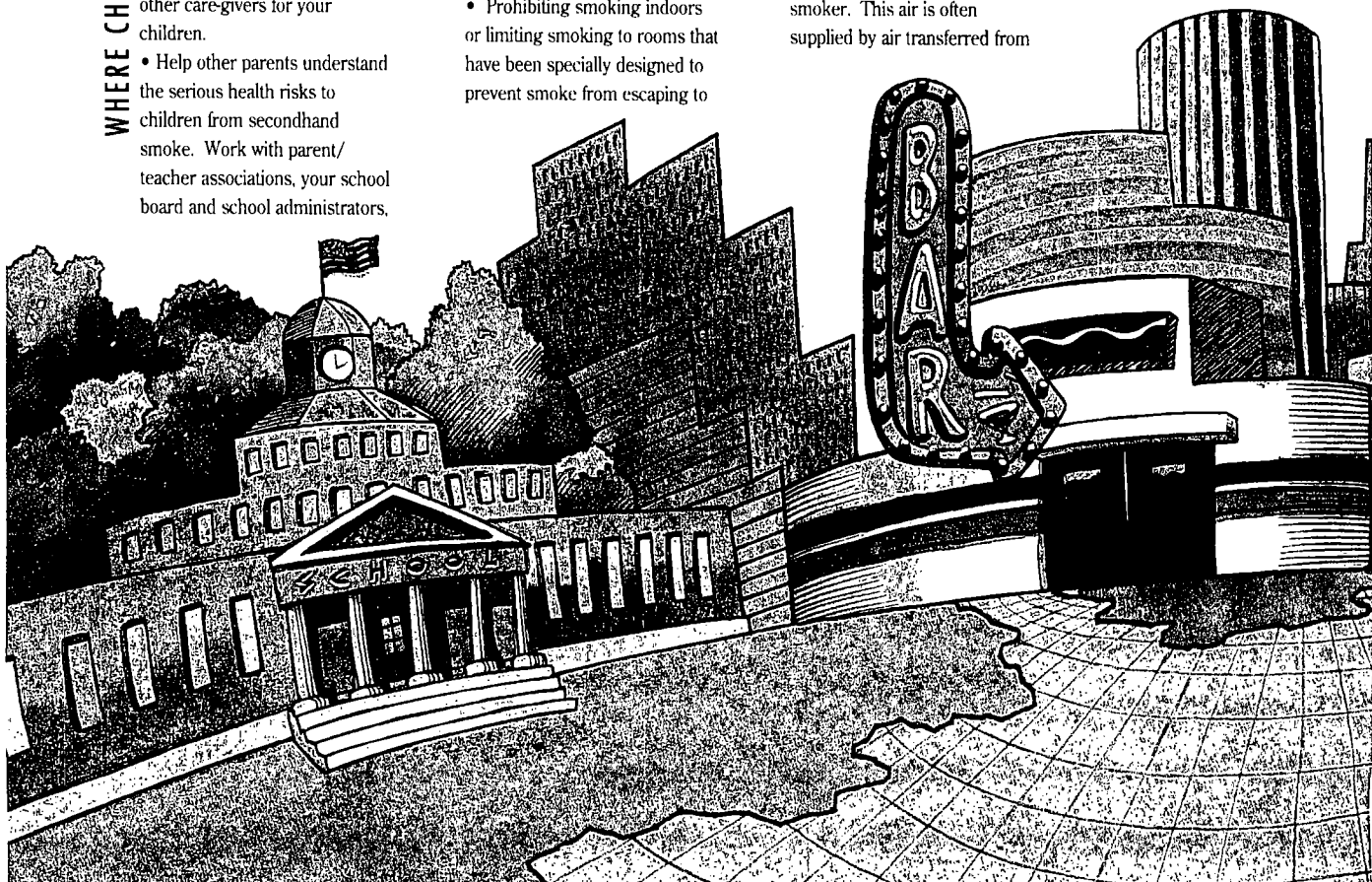
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The costs associated with establishing properly designed smoking rooms vary from building to building, and are likely to be greater than simply eliminating smoking entirely.

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If you choose to smoke, here are some things you can do to help protect the people close to you:

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• Keep your home smoke free. Nonsmokers can get lung cancer from exposure to your smoke. Because smoke lingers in the air, people may be exposed even if they are not present while you smoke. If you must smoke inside, limit smoking to a room where you can open windows for cross-ventilation. Be sure the room in which you smoke has a working smoke detector to lessen the risk of fire.

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- Don't smoke in an automobile with the windows closed if passengers are present. The high concentration of smoke in a small, closed compartment substantially increases the exposure of other passengers.

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SECONDHAND SMOKE

What You Can Do About Secondhand Smoke

As Parents,  Decisionmakers,

and  Building Occupants



What Is Secondhand Smoke?

WHAT IS SECONDHAND SMOKE?

- Secondhand smoke is a mixture of the smoke given off by the burning end of a cigarette, pipe, or cigar, and the smoke exhaled from the lungs of smokers.
- This mixture contains more than 4,000 substances, more than 40 of which are known to cause cancer in humans or animals and many of which are strong irritants.
- Secondhand smoke is also called environmental tobacco smoke (ETS); exposure to secondhand smoke is called involuntary smoking, or passive smoking.

SECONDHAND SMOKE CAN CAUSE LUNG CANCER IN NONSMOKERS

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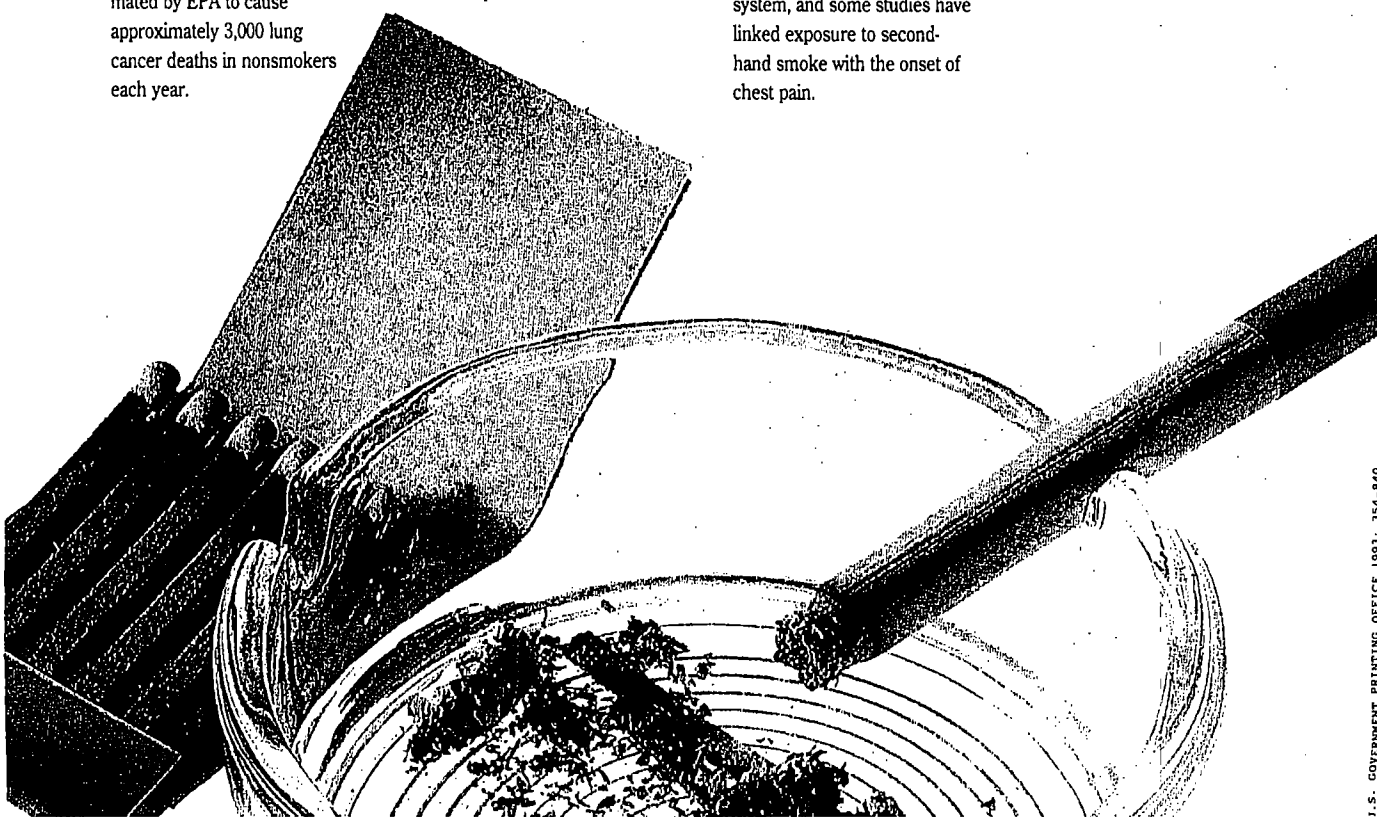
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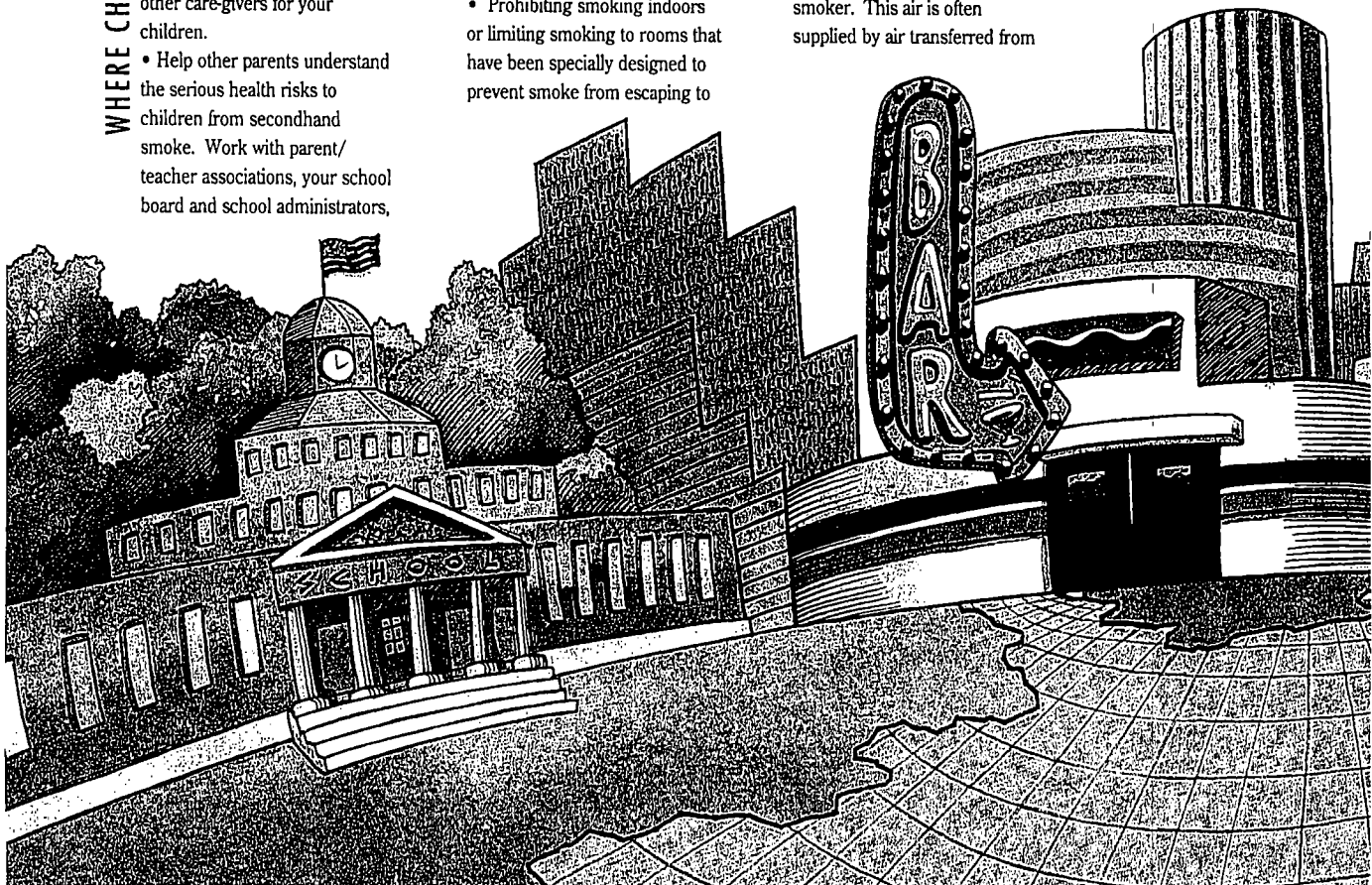
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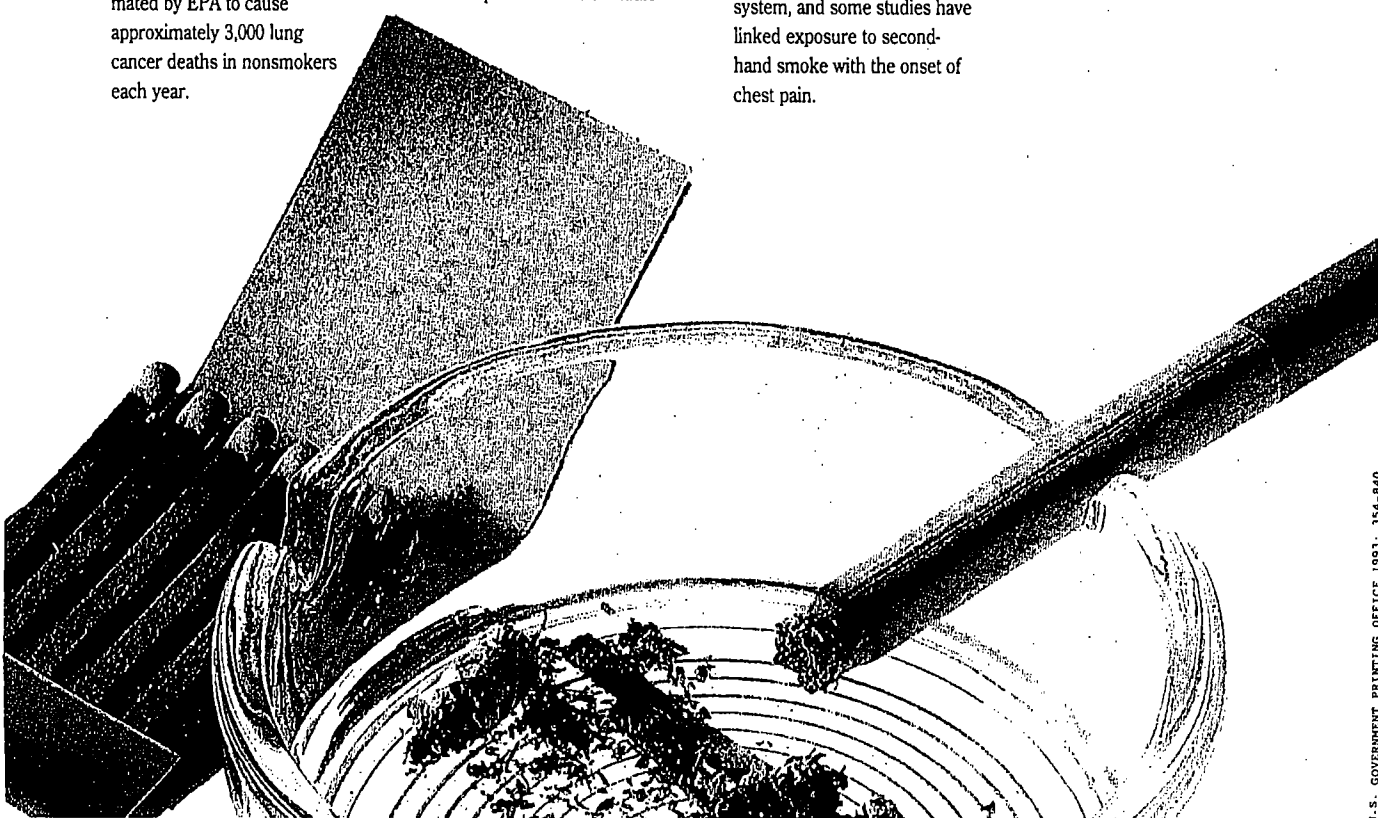
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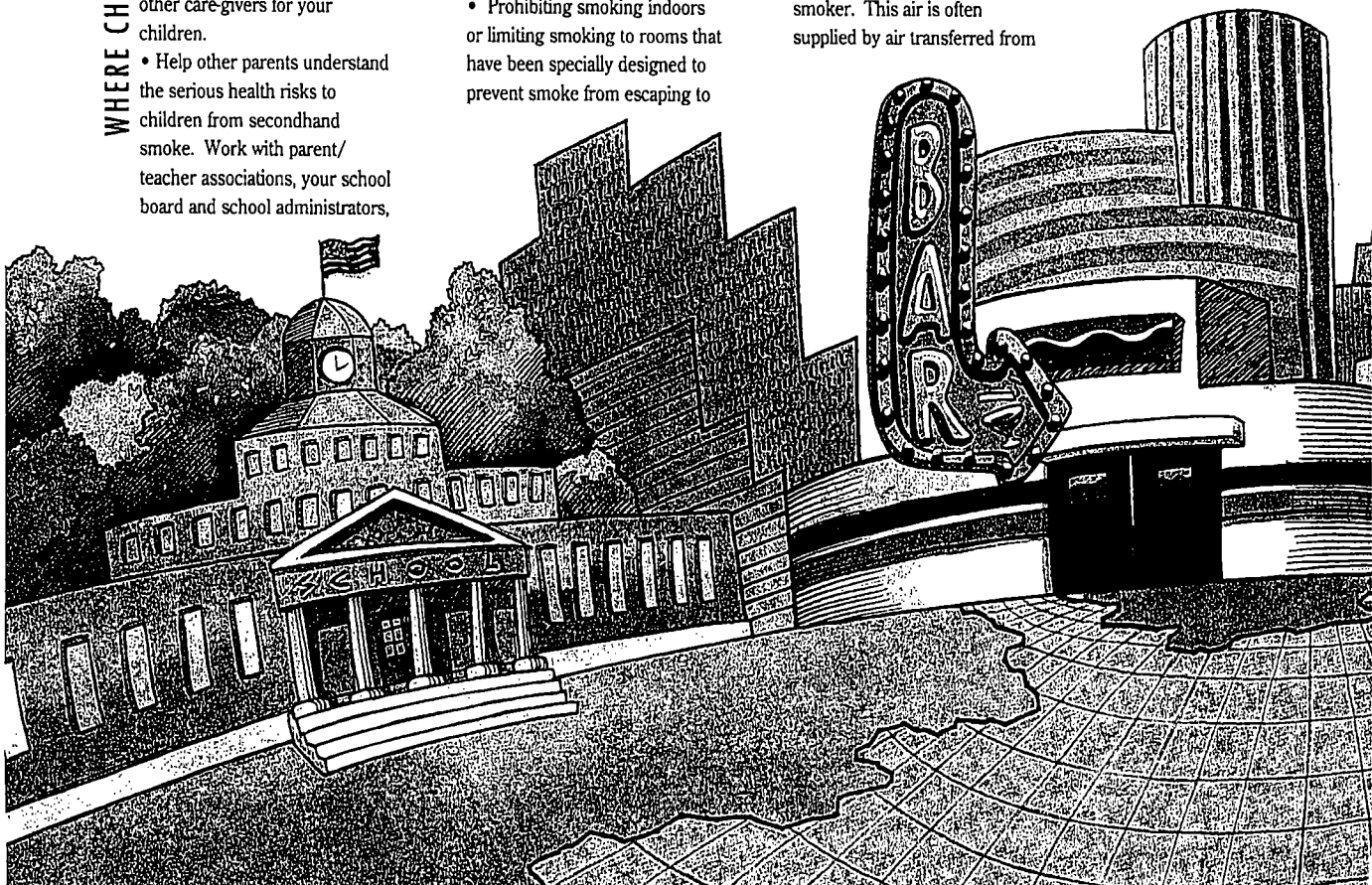
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