This Health Hazard Evaluation (HHE) report and any recommendations made herein are for the specific facility evaluated and may not be universally applicable. Any recommendations made are not to be considered as final statements of NIOSH policy or of any agency or individual involved. Additional HHE reports are available at http://www.cdc.gov/niosh/hhe/reports

HETA 92-339-2323
JUNE 1993
HENNEPIN COUNTY HEALTH SERVICES BUILDING
MINNEAPOLIS, MINNESOTA

NIOSH INVESTIGATORS:
Anthony T. Zimmer, CIH
Nancy Clark Burton, MS

SUMMARY

On August 14, 1992, the National Institute for Occupational Safety and Health (NIOSH) received a written request for a Health Hazard Evaluation from a management representative of the Hennepin County Health Services Building. Specifically, an indoor air quality study was requested for government services employees working throughout the building. A number of employees had reported health symptoms of upper respiratory irritation, headaches and dry eyes which they associated with the building. Information provided prior to the initial survey identified floors 9 and 10 as complaint areas.

A site visit was conducted on October 27-28, 1992. An opening conference was held with the Hennepin County Health Services Building Indoor Air Quality Study Committee. Based on discussions in the opening conference, NIOSH focused upon floors 12, 10, 9, 7 and the lower level (LL) to represent complaint and non-complaint areas. The investigation included the following actions: (1) a walk-through of the identified floors to survey the work activities and office layout, (2) an examination of heating, ventilating, and air conditioning (HVAC) systems serving each floor and, (3) an environmental survey which included measurements for particulates, carbon dioxide (CO_2), temperature, and relative humidity (RH).

Environmental sampling was conducted at 20 different sample locations throughout floors 12, 10, 9, 7 and LL during the early morning and late afternoon. The environmental sampling revealed particulate, temperature, relative humidity and CO_2 conditions that are commonly found in indoor environments. The HVAC systems appeared to reduce the particle counts by approximately 50% when compared to the outside particle counts. The temperature (average 74°F, range 70 to 77°F) and relative humidity (average 32%, range 29 to 35%) measurements on the sampled floors were well within the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) comfort guidelines corresponding to those conditions in which 80% or more of the building occupants would be expected to find the environment thermally comfortable. Additionally, the CO_2 concentrations measured on the sampled floors were below 1,000 ppm suggesting that floors 12, 10, 9, 7 and LL were being adequately ventilated with outside air.

The NIOSH investigators found no clear environmental causes for the symptoms reported by employees. However, a deficiency was noted during an examination of several heating, ventilating, and air conditioning (HVAC) systems. A recommendation was made to increase the slope of the condensate collection pans in HVAC systems with standing water.

Keywords: SIC 9431 (Administration of Public Health Programs), indoor air quality, indoor environmental quality, ventilation.

INTRODUCTION

On August 31, 1992, the National Institute for Occupational Safety and Health (NIOSH) received a written request for a health hazard evaluation from a management representative of the Hennepin County Health Services Building. Specifically, an indoor air quality study was requested for government services employees working throughout the building. A number of employees had reported repeated complaints of upper respiratory irritation, headaches and dry eyes. Information provided prior to the initial survey identified floors 9 and 10 as complaint areas.

A site visit was conducted on October 27-28, 1992. An opening conference was held with the Hennepin County Health Services Building Indoor Air Quality Study Committee. This committee was comprised of facility management, facility maintenance staff, occupational health professionals, and union representatives. Based on discussions in the opening conference, NIOSH focused upon floors 12, 10, 9, 7 and the lower level (LL) to represent complaint and non-complaint areas. A closing conference was held with the members of the IAQ study committee prior to departure to discuss the findings.

BACKGROUND

The Hennepin County Health Services Building is a 12 floor, rectangular office building located in downtown Minneapolis, Minnesota. No parking garages are located within the building although there is a subgrade, lower level. The building was constructed in two phases which involved occupancy of floors LL through 8 in August 1988 and occupancy of the remaining floors in January 1989. Approximately 800 personnel are employed in the facility to provide community health services. A designated smoking area is located on the second floor. The net square footage of each floor is 11,000 square feet (ft^2).

The HVAC systems in the building are variable air volume (VAV) design. Each floor has a dedicated VAV unit with the exception of the first and second floors which share a VAV unit. Each unit has variable speed return and supply air fans. The heated and chilled water for the units is provided via a remote energy plant. No humidification is provided by these HVAC systems. Makeup air (outside air) is provided via air inlets located on the rooftop and a vertical shaft which connects the HVAC systems on each floor. The nominal design makeup air flow is set at a minimum 15% of total airflow. The makeup air flow will vary from 15% up to 100% of total airflow with favorable outside conditions.

Since late 1989, employees (especially those located on the ninth and tenth floors) have reported symptoms they associated with poor indoor environmental quality. In early 1990, an internal investigation was conducted with subsequent actions taken to improve the indoor environmental quality. The complaints diminished during the cooling season, but increased during the heating season. In early 1991, a outside agency conducted an investigation and made recommendations to improve the indoor environmental quality. Following this survey, the indoor complaints diminished, but again increased with the onset of the heating season. According to the building maintenance supervisor, the indoor relative humidity level averaged 10-15% during the heating season. At the time of the NIOSH investigation, a second agency was in the process of conducting an investigation.

Complaints, reported to the health unit for the approximately eighteen months prior to the NIOSH site visit, had been summarized by the staff epidemiologist. Thirty-eight individuals had filed reports. The most commonly reported symptoms were eye irritation (68%), headache (58%), nose or throat irritation (48%), sinus congestion (40%), and fatigue/drowsiness (34%). Twelve of the employees had a past history of allergies. At the time of the NIOSH investigation, the union was developing a survey for its membership to elicit information about work activities, environmental conditions, and symptoms that employees thought were associated with working in the building.

EVALUATION CRITERIA

NIOSH investigators have completed over 1100 investigations of the occupational indoor environment in a wide variety of non-industrial settings. The majority of these investigations have been conducted since 1979.

The symptoms and health complaints reported to NIOSH by building occupants have been diverse and usually not suggestive of any particular medical diagnosis or readily associated with a causative agent. A typical spectrum of symptoms has included headaches, unusual fatigue, varying degrees of itching or burning eyes, irritations of the skin, nasal congestion, dry or irritated throats and other respiratory irritations. Typically, the workplace environment has been implicated because workers report that their symptoms lessen or resolve when they leave the building.

A number of published studies have reported high prevalences of symptoms among occupants of office buildings.[1,2,3,4,5] Scientists investigating indoor environmental problems believe that there are multiple factors contributing to building-related occupant complaints.[6,7] Among these factors are imprecisely defined characteristics of heating, ventilating, and air-conditioning (HVAC) systems, cumulative effects of exposure to low concentrations of multiple chemical pollutants, odors, elevated concentrations of particulate matter, microbiological contamination, and physical factors such as thermal comfort, lighting, and noise.[8,9,10,11,12,13] Indoor environmental pollutants can arise from either outdoor sources or indoor sources.[14]

There are also reports describing results which show that occupant perceptions of the indoor environment are more closely related than any measured indoor contaminant or condition to the occurrence of symptoms.[15,16,17] Some studies have shown relationships between psychological, social, and organizational factors in the workplace and the occurrence of symptoms and comfort complaints.[17,18,19,20]

Less often, an illness may be found to be specifically related to something in the building environment. Some examples of potentially building-related illnesses are allergic rhinitis, allergic asthma, hypersensitivity pneumonitis, Legionnaires' disease, Pontiac fever, carbon monoxide poisoning, and reaction to boiler corrosion inhibitors. The first three conditions can be caused by various microorganisms or other organic material. Legionnaires' disease and Pontiac fever are caused by *Legionella* bacteria. Sources of carbon monoxide include vehicle-engine exhaust emissions and inadequately ventilated kerosene heaters or other fuel-burning appliances. Exposure to boiler additives can occur if boiler steam is used for humidification or is released by accident.

Problems NIOSH investigators have found in the non-industrial indoor environment mirror those discussed in the preceding three paragraphs, and have included poor air quality due to ventilation system deficiencies, overcrowding, volatile organic chemicals (from building materials and office furnishings, machines, and other contents), tobacco smoke, microbiological contamination, and outside air pollutants; comfort problems due to improper temperature and relative humidity conditions, poor lighting, and unacceptable noise levels; adverse ergonomic conditions; and job-related psychosocial stressors. In most cases, however, these problems could not be directly linked to the reported health effects.

Standards for exposures to chemical substances and other agents specifically for the non-industrial indoor environment do not exist. NIOSH, the Occupational Safety and Health Administration (OSHA), and the American Conference of Governmental Industrial Hygienists (ACGIH) have published regulatory standards or recommended limits for occupational exposures.[21,22,23] With few exceptions, airborne pollutant concentrations observed in the office work environment fall well below these published occupational standards or recommended exposure limits. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has published recommended building ventilation design criteria and thermal comfort guidelines.[24,25] The ACGIH has also developed a manual of guidelines for approaching investigations of building-related complaints that might be caused by airborne living organisms or their effluents.[26]

Measurement of indoor environmental contaminants has rarely proved to be helpful in determining the cause of symptoms and complaints except where there are strong or unusual sources, or a proven relationship between contaminants and specific building-related illnesses. The low-level concentrations of particles and variable mixtures of organic materials usually found are difficult to interpret and usually impossible to causally link to observed and reported health symptoms. However, measuring ventilation and comfort indicators has proven useful in the early stages of an investigation in providing information relative to the proper functioning and control of HVAC systems.

NIOSH and the Environmental Protection Agency (EPA) jointly published a manual on building air quality, written to help prevent environmental problems in buildings and solve problems when they occur.[27] This manual suggests that indoor environmental quality (IEQ) is a constantly changing interaction of a complex set of factors. Four of the most important elements involved in the development of IEQ problems are: 1) a source of odors or contaminants; 2) a problem with the design or operation of the HVAC system; 3) a pathway between the contaminant source and the location of the complaint and; 4) the building occupants. A basic understanding of these factors is critical to preventing, investigating, and resolving IEQ problems.

The basis for measurements made during this evaluation are listed below.

Carbon Dioxide

Carbon dioxide (CO_2) is a normal constituent of exhaled breath and, if monitored, may be useful as a screening technique to evaluate whether adequate quantities of fresh air are being introduced into an occupied space. The ANSI/ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality, recommends outdoor air supply rates of 20 cubic feet per minute per person (cfm/person) for office spaces and conference rooms, 15 cfm/person for reception areas, and 60 cfm/person for smoking lounges, and provides estimated maximum occupancy figures for each area.[24]

Indoor CO_2 concentrations are normally higher than the generally constant ambient CO_2 concentration which ranges from 300-350 parts per million (ppm). When indoor CO_2 concentrations exceed 1000 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected. Elevated CO_2 concentrations suggest that the concentration of other indoor contaminants may also be increased.

Temperature and Relative Humidity

The perception of comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperatures. Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. ANSI/ASHRAE Standard 55-1981 specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally comfortable.[25]

METHODS

The NIOSH investigation consisted of the following: (1) a walk-through of floors 12, 10, 9, 7 and 1 to survey the work activities and office layout; (2) an examination of heating, ventilating, and air conditioning (HVAC) systems servicing the affected building floors and; (3) an environmental survey which included measurements for particulates, carbon dioxide (CO_2), temperature, and relative humidity (RH) during the workday.

Real-time particle count measurements were collected using a Met One, Model 227B Particulate Counter. The Model 227B is a hand held, laser particulate counter which counts particles greater than or equal to 0.3 microns ($\geq 0.3 \times 10^{-6}$ meters) in size. The device was used to qualitatively determine the presence of small particles for comparison between office areas and the outside.

Real-time carbon dioxide (CO_2) levels were measured using a Gastech Model RI-411A, Portable CO_2 Indicator. This portable, battery-operated instrument monitors CO_2 via non-dispersive infrared absorption with a range of 0-4975 parts per million (ppm), and a sensitivity of 25 ppm. Instrument zeroing and calibration were performed prior to use with zero air and a known concentration of CO_2 span gas (800 ppm). Confirmation of calibration was conducted throughout the instrument use period.

Real-time temperature and RH measurements were made using a Vaisala, Model HM 34, battery-operated meter. This meter is capable of providing direct readings for dry bulb temperature and RH ranging from -4 to 140ºF, and 0 to 100% RH, respectively.

RESULTS AND DISCUSSION

Walkthrough/HVAC System

A general walkthrough of floors 12, 10, 9, 7 and LL was accomplished on the afternoon of October 27. Areas surveyed included the general administrative areas, individual offices, hallways, elevators, and bathrooms. No unusual odor or point sources were noted during the walkthrough visit of these areas. The smoking area for the building, located on the second floor, was also inspected. According to the building maintenance supervisor, the smoking area was operated and maintained according to ASHRAE standards. A dedicated exhaust system removed air from the smoking area to the outside of the building. The area was under negative pressure in relation to adjacent areas as determined through the use of smoke powder.

The HVAC systems on each floor were inspected for excess particulate buildup on the filters and evidence of standing water in the condensate collection pans. The air supplied to each floor is filtered through pleated filters followed by bag filters. In each HVAC system inspected, the filters appeared free of excess particulates with no evidence of filter bypass. According to the building maintenance supervisor, the pleated filters are changed out quarterly and the bag filters are changed out annually. Standing water was noted in the condensate collection pans on floors 10 and 12. Standing water is considered undesirable since the water could act as a reservoir for biological growth. Additionally, the outside air intakes, located on the rooftop, were visually inspected. The intakes appeared free of debris and there was no evidence of bird roosting activities in or around the outside air intakes.

Environmental Survey

The environmental survey included selecting appropriate sample sites and conducting environmental sampling. The survey locations were strategically selected on floors 12, 10, 9, 7 and LL to represent: (1) a particular work environment such as a hallway, an administrative area cubicle or an individual office and (2) locations previously identified as complaint areas to determine whether or not these areas were (from a measurement standpoint) different from non-complaint areas. Twenty different sample locations were selected throughout the identified floors. Measurements were taken at each location in the early morning and late afternoon to determine variations throughout the day. The environmental sampling consisted of measurements for particulates, carbon dioxide, temperature and relative humidity. These measurements were used as aids in assessing indoor environmental quality.

Particulates

The average particulate count on all floors was 800,000 particles per cubic foot (range 720,000 to 960,000). For comparison the average outside concentration was 1,670,000 particles per cubic foot (range 2,690,000 to 650,000). In other words, the HVAC systems reduced the particles count ($\geq 0.3 \times 10^{-6}$ meters in size) by approximately 50% when compared to the outside counts. See Table 1 for further information regarding the particulate results.

Table 1

Environmental Monitoring Results
Particulates (Particles per cubic foot)

	Average		Range	
Floor	Morning	Afternoon	High	Low
12	1,090,000	390,000	1,150,000	240,000
10	1,670,000	260,000	3,000,000	250,000
9	1,340,000	320,000	1,500,000	290,000
7	1,170,000	270,000	1,330,000	240,000

Carbon Dioxide

The average CO_2 concentrations on all floors was 480 ppm (range 350 to 625 ppm). For comparison, the outside concentration averaged 335 ppm (range 325 to 350 ppm). In all locations, the CO_2 levels were below 1,000 ppm suggesting that the areas sampled were being adequately ventilated with outside air.[24] See Table 2 for further information regarding the CO_2 results.

Temperature and Relative Humidity

The average temperature for all floors was 74°F (range 70 to 77°F). The average relative humidity for all floors was 32% (range 29 to 35%). See Tables 3 and 4 for further information regarding the temperature and relative humidity results.

Table 2

Environmental Monitoring Results
Carbon Dioxide (CO_2)

Floor	Average	Range	
		High	Low
12	460	500	425
10	510	575	425
9	480	550	425
7	400	475	350
LL	565	625	525
Outside	335	350	325

Table 3

Environmental Monitoring Results
Temperature (°F)

Floor	Average	Range	
		High	Low
12	74	77	73
10	74	77	72
9	73	73	72
7	72	74	70
LL	75	76	73
Outside	53	66	40

Table 4

Environmental Monitoring Results
Relative Humidity (%)

Floor	Average	Range	
		High	Low
12	31	34	29
10	32	34	29
9	32	34	31
7	32	35	31
LL	32	33	31
Outside	48	64	32

For comparison, the outside temperature and relative humidity averaged were 53°F (range 40 to 66°F)and 48% (range 32 to 64%), respectively. These building results when compared to the ASHRAE thermal comfort chart (see Figure 1) fall within the comfort zones for summer and winter periods which could be expected considering the survey date (October 27-28, 1992). Of the 40 measurements taken at various locations and time periods, no areas could be specifically identified as consistently cool or warm. The results obtained throughout floors 12, 10, 9, 7 and LL fall within the summer and winter "comfort" parameters as defined by ASHRAE. In other words, those conditions in which 80% or more of the building occupants would be expected to find the environment thermally comfortable.[25]

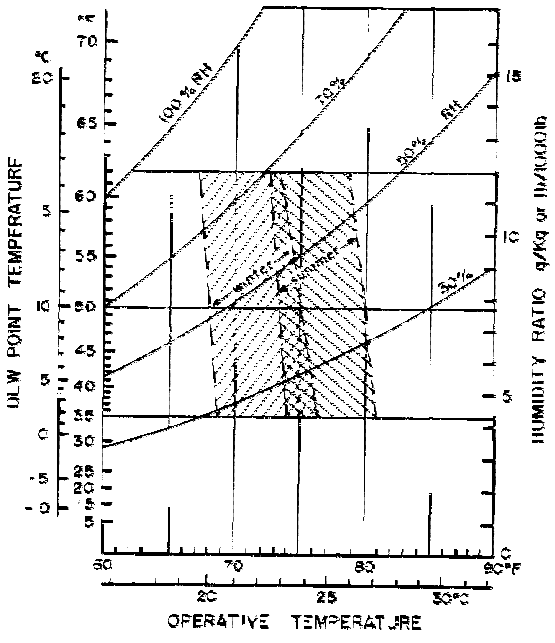

Figure 1: ASHRAE 55-1981

CONCLUSIONS

There were no clear environmental causes for the complaints and symptoms reported by the employees. The environmental sampling performed on October 27-28, 1992, revealed particulate, temperature, relative humidity and CO_2 conditions that are commonly found in indoor environments. The HVAC systems appeared to reduce the particle counts by approximately 50% when compared to the outside levels. The temperature and relative humidity measurements were well within ASHRAE comfort guidelines corresponding to those conditions in which 80% or more of the building occupants would be expected to find the environment thermally comfortable. Additionally, the CO_2 concentrations measured on that day were below 1,000 ppm, suggesting that floors 12, 10, 9, 7 and LL were being adequately ventilated with outside air. The building had low RH levels during the heating season which may produce discomfort from dryness but low humidities also help restrict microbiological growth.[27] Therefore, the concerns over discomfort should be balanced against the risk of increased microbiological growth associated with humidification.

RECOMMENDATIONS

Standing water was noted in the condensate collection pans on floors 12 and 10 which could act as a reservoir for microbial growth. To prevent this situation, the slope to the collection drains should be increased. Additionally, the HVAC condensate collection pans on floors not inspected during the NIOSH investigation should be evaluated for standing water during the cooling season.

The Hennepin County Health Services Building Indoor Air Quality Study Committee should continue to be used as an instrument to address and resolve IEQ issues. This committee serves as a valuable focal point where employees can address and resolve IEQ issues with facility and building management.

REFERENCES

1. Kreiss KK, Hodgson MJ [1984]. Building associated epidemics. In: Walsh PJ, Dudney CS, Copenhaver ED, eds. Indoor air quality. Boca Raton, FL: CRC Press, pp. 87–108.

2. Gammage RR, Kaye SV, eds. [1985]. Indoor air and human health: Proceedings of the Seventh Life Sciences Symposium. Chelsea, MI: Lewis Publishers, Inc.

3. Woods JE, Drewry GM, Morey PR [1987]. Office worker perceptions of indoor air quality effects on discomfort and performance. In: Seifert B, Esdorn H, Fischer M, *et al.*, eds. Indoor air '87, Proceedings of the 4th International Conference on Indoor Air Quality and Climate. Berlin Institute for Water, Soil and Air Hygiene.

4. Skov P, Valbjorn O [1987]. Danish indoor climate study group. The "sick" building syndrome in the office environment: The Danish town hall study. Environ Int *13*:399-349.

5. Burge S, Hedge A, Wilson S, Bass JH, Robertson A [1987]. Sick building syndrome: A study of 4373 office workers. Ann Occup Hyg *31*:493-504.

6. Kreiss K [1989]. The epidemiology of building-related complaints and illness. Occupational Medicine: State of the Art Reviews *4*(4):575–592.

7. Norbäck D, Michel I, Widstrom J [1990]. Indoor air quality and personal factors related to the sick building syndrome. Scan J Work Environ Health *16*:121–128.

8. Morey PR, Shattuck DE [1989]. Role of ventilation in the causation of building-associated illnesses. Occupational Medicine: State of the Art Reviews *4*(4):625–642.

9. Mendell MJ, Smith AH [1990]. Consistent pattern of elevated symptoms in air-conditioned office buildings: A reanalysis of epidemiologic studies. Am J Public Health *80*(10):1193–1199.

10. Molhave L, Bachn B, Pedersen OF [1986]. Human reactions to low concentrations of volatile organic compounds. Environ Int *12*:167–176.

11. Fanger PO [1989]. The new comfort equation for indoor air quality. ASHRAE J *31*(10):33–38.

12. Burge HA [1989]. Indoor air and infectious disease. Occupational Medicine: State of the Art Reviews *4*(4):713–722.

13. Robertson AS, McInnes M, Glass D, Dalton G, Burge PS [1989]. Building sickness, are symptoms related to the office lighting? Ann Occup Hyg *33*(1):47–59.

14. Levin H [1989]. Building materials and indoor air quality. Occupational Medicine: State of the Art Reviews *4*(4):667–694.

15. Wallace LA, Nelson CJ, Dunteman G [1991]. Workplace characteristics associated with health and comfort concerns in three office buildings in Washington, D.C. In: Geshwiler M, Montgomery L, and Moran M, eds. Healthy buildings. Proceedings of the ASHRAE/ICBRSD conference IAQ '91. Atlanta, Ga.: The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

16. Haghighat F, Donnini G, D'Addario R [1992]. Relationship between occupant discomfort as perceived and as measured objectively. Indoor Environ *1*:112–118.

17. NIOSH [1991]. Hazard evaluation and technical assistance report: Library of Congress Madison Building, Washington, D.C. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. HHE 88–364–2104 — Vol. III.

18. Skov P, Valbjørn O, Pedersen BV [1989]. Influence of personal characteristics, job-related factors, and psychosocial factors on the sick building syndrome. Scand J Work Environ Health *15*:286–295.

19. Boxer PA [1990]. Indoor air quality: A psychosocial perspective. J Occup Med *32*(5):425–428.

20. Baker DB [1989]. Social and organizational factors in office building-associated illness. Occupational Medicine: State of the Art Reviews *4*(4):607–624.

21. NIOSH [1992]. NIOSH recommendations for occupational safety and health: Compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health. DHHS(NIOSH) Publication No. 92–100.

22. Code of Federal Regulations [1989]. Air contaminants — permissible exposure limits. 29 CFR 1910.1000. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA).

23. ACGIH [1991]. 1991–92 Threshold limit values for chemical substances and physical agents, and biological exposure indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

24. ASHRAE [1989]. ASHRAE™ Standard 62-1989: Ventilation for acceptable indoor air quality. Atlanta, GA: American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Inc.

25. ASHRAE [1981]. ANSI/ASHRAE Standard 55-1981: Thermal environmental conditions for human occupancy. Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

26. ACGIH [1989]. Guidelines for the assessment of bioaerosols in the indoor environment. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

27. NIOSH [1991]. Building air quality: a guide for building owners and facility managers. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 91-114.

AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

Anthony T. Zimmer, CIH
Industrial Hygiene Engineer
Industrial Hygiene Section

Nancy C. Burton, MS
Industrial Hygienist
Industrial Hygiene Section

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations and Field Studies

Document formatted by:

Donna M. Humphries
Office Automation Assistant
Industrial Hygiene Section

DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report may be freely reproduced and are not copyrighted. Single copies of this report will be available for a period of 90 days from the date of this report from the NIOSH Publications Office, 4676 Columbia Parkway, Cincinnati, Ohio 45226. To expedite your request, include a self-addressed mailing label along with your written request. After this time, copies may be purchased from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati office (800/356-4674).

Copies of this report will be sent to:

1. Hennepin County Health Services IAQ Committee
2. AFSCME Union, Council 14
3. OSHA, Region V

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.