U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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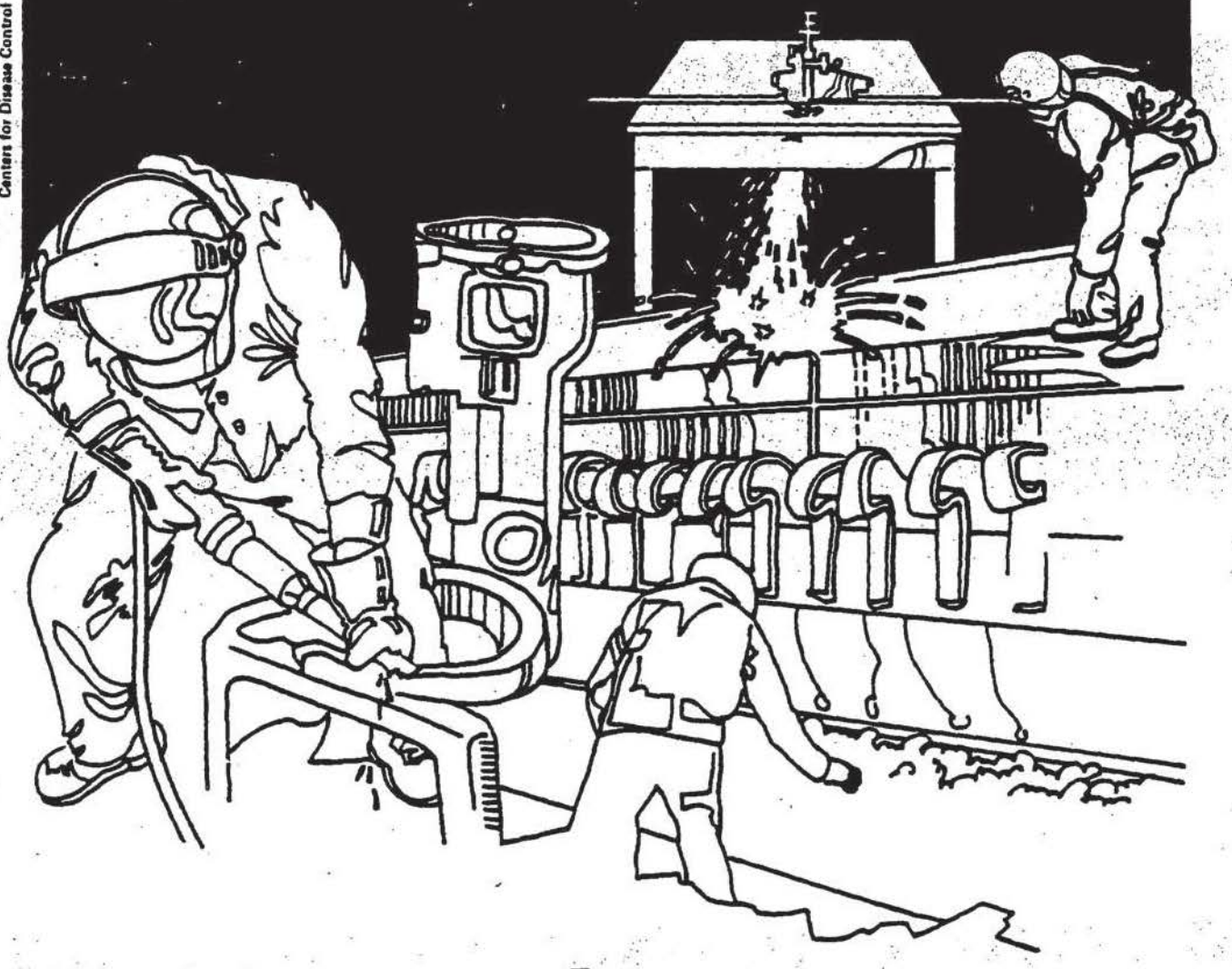

Health Hazard Evaluation Report

HETA 85-307-1608
FRANCES PERKINS BLDG
WASHINGTON, D.C.

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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NIOSH INVESTIGATOR:
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I. SUMMARY

In April 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation at the Frances Perkins Building, Washington, D.C. Office workers requested the evaluation because of concern about possible lack of fresh air and potential exposure to carbon monoxide (CO) from indoor parking garages and the I-395 tunnel.

On May 28, 1985, a NIOSH investigator toured the building, reviewed ventilation specifications and took measurements of CO and carbon dioxide (CO_2) using colorimetric detector tubes.

About 3600 employees work in the six story, 10-year old building located at 200 Constitution Avenue. The building occupies about 1.8 million square feet of which 800,000 square feet is currently used as office space. Fifty-five air handlers are designed to supply at least 1.5 million cubic feet per minute (CFM) of air which contains a minimum of 15% fresh air. Thus, an average of 60 CFM of fresh air per person is the minimum amount being supplied to the offices according to current ventilation specifications. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) recommends a minimum of 20 CFM fresh air per person. At mid-afternoon CO_2 levels were 500-600 ppm in several offices which had previously received complaints about "stuffy air". Outdoor CO_2 concentrations at that time were about 500 ppm.

At least 200 feet separates any of the building's fresh air intakes from the street tunnel and parking garage exhausts. CO concentrations in the offices ranged from 2-6 ppm since the Department of Labor began monitoring in December 1984. CO levels in the offices were less than 5 ppm during the NIOSH visit. The NIOSH recommended exposure limit for CO is 35 ppm.

On the basis of the data collected in this evaluation, it was determined that there were no hazards from the lack of fresh air or from CO exposure in the Frances Perkins Building. Recommendations for continued monitoring of CO and CO_2 are presented in Section VII of this report.

KEYWORDS: SIC 9199, office building, office workers, carbon monoxide, CO, carbon dioxide, CO_2.

II. INTRODUCTION

In April 1985, NIOSH received a request for a health hazard evaluation at the Frances Perkins Building, Washington D.C. The request was submitted by employees of the U.S. Department of Labor (DOL) who were concerned about the possible lack of fresh air and potential carbon monoxide (CO) contamination in their offices.

III. BACKGROUND

About 3600 employees work in the six-story, 10-year old building located at 200 Constitution Avenue. The building occupies about 1.8 million square feet of which 800,000 square feet is currently used as office space.

The DOL took over the responsibility for managing the facility from the General Services Administration about three years ago. The department is currently renovating the offices to make room for 800-1400 additional employees, causing concern among the present occupants regarding future fresh air adequacy. After renovation most workers will be situated in an open office concept using "New Systems" furniture which includes partitions extending 0-2 inches from the floor to 2-3 feet from the ceiling.

Concern over CO contamination arose because of the building's three indoor parking garages and the I-395 tunnel running underneath the building.

IV. METHODS

A NIOSH investigator met with building managers and employee representatives on May 28, 1985. DOL results of CO monitoring were reviewed along with specifications for the building's air handling system. A tour of the building focused on the location of garage and tunnel exhausts in relation to fresh air intakes and the examination of office areas which tended to produce the greatest number of employee complaints. Measurements of carbon dioxide (CO_2) and CO were collected in those areas using colorimetric detector tubes.

V. EVALUATION CRITERIA

Building-Related Illness Episodes

Building-related illness episodes have been reported more frequently in recent years as buildings have been made more air-tight in order to conserve energy and to reduce air conditioning expenses. Modern high-rise office buildings are constructed primarily of steel, glass, and concrete, with large windows that cannot be opened, thus making the building totally dependent on mechanical systems for air conditioning.

Contaminants may be present in make-up air or may be introduced from indoor activities, furnishings, building materials, surface coatings, and air handling systems and treatment components. Symptoms often reported are eye, nose, and throat irritation, headache, fatigue, and sinus congestion. Occasionally, upper respiratory irritation and skin rashes are reported. In some cases, the cause of the symptoms has been ascribed to an airborne contaminant, such as formaldehyde, tobacco smoke, or insulation particles, but most commonly a single cause cannot be pinpointed.

Imbalance or malfunction of the air conditioning system is commonly identified, and in the absence of other theories of causation, illnesses are usually attributed to inadequate ventilation, heating/cooling, or humidification.

In 1981, the National Research Council (National Academy of Sciences) issued a report urging a major national effort be mounted to study the subject of indoor air pollution. Some of the major types of contaminants found in indoor air are:

1. Products of combustion

   Carbon monoxide and nitrogen dioxide are often considered the most important toxic products of the combustion of fossil fuels and other organic materials. Gas stoves may be a significant source of these pollutants. Carbon monoxide is an asphyxiant, and nitrogen dioxide a pulmonary irritant.

2. Formaldehyde

   Formaldehyde and other aldehydes may be released from foam plastics, carbonless paper, particle board, plywood, and textile fabrics. Formaldehyde is an irritant to the eyes, nose, mouth, and throat. It is also a possible human carcinogen, based on its ability to produce nasal cancer in rats.

3. Sprayed-on insulation materials

   Asbestos, fibrous glass, and mineral wool fibers have been used in some buildings in sprayed-on fireproofing insulation for walls, ceilings, and structural steel beams. Fibers and dust particles may be dislodged from the insulation and become airborne. Asbestos fibers can cause pulmonary disease and cancer. Mineral wool and fibrous glass particles are irritants.

4. Tobacco smoke

Tobacco smoke contains several hundred toxic substances, the more important of which are: carbon monoxide, nitrogen dioxide, hydrogen cyanide, formaldehyde, hydrocarbons, ammonia, benzene, hydrogen sulfide, benzo(a)pyrene, tars, and nicotine. Tobacco smoke can irritate the respiratory system and, in allergic or asthmatic persons, often results in eye and nasal irritation, coughing, wheezing, sneezing, headache, and other related sinus problems. People who wear contact lenses often complain of burning, itching, and tearing eyes when exposed to cigarette smoke. While cigarette smoking is the leading cause of lung cancer in the United States, currently available evidence is not sufficient to conclude that passive or involuntary smoking causes lung cancer in non-smokers[A].

5. Microorganisms and allergens

Microorganisms have been spread through ventilation systems in buildings where air filters became wet and moldy, where pools of stagnant water accumulated under air conditioning cooling coils, and where decaying organic matter was found near air conditioning intakes. Health effects may be infections, irritation, or allergic symptoms.

Ventilation Evaluation Criteria

Neither NIOSH nor OSHA has developed ventilation criteria for general offices. Criteria often used by design engineers are the guidelines published by ASHRAE.

Until recently, the ASHRAE Ventilation Standard 62-73 (1973) was utilized, but recommendations were based on studies performed before the more modern, air-tight office buildings became common. These older buildings permitted more air infiltration through leaks in cracks and interstices, around windows and doors, and through floors and walls. Modern office buildings are usually much more airtight and permit less air infiltration. Due to the reduced infiltration, ASHRAE questioned whether the 1973 minimum ventilation values assure adequate outdoor air supply in modern, air-tight buildings.

Subsequently, ASHRAE has revised its standard and has published the new standard, ASHRAE 62-1981, "Ventilation for Acceptable Indoor Air Quality." The new standard is based on an occupant density of 7 persons per 1000 ft^2 of floor area, and recommends higher ventilation rates for areas where smoking is permitted.

The new ASHRAE standard states that indoor air quality for "General Offices" shall be considered acceptable if the supply of outdoor air is sufficient to reduce carbon dioxide to less than 2500 ppm and to control contaminants, such as various gases, vapors, microorganisms, smoke, and other particulate matter, so that concentrations known to impair health or cause discomfort to occupants are not exceeded. However, the threshold levels for health effects from these exposures are poorly documented. For "General Offices" where smoking is not permitted, the rate recommended under the new standard is 5 cfm of outdoor air per person. Higher ventilation rates are recommended for spaces where smoking is permitted because tobacco smoke is one of the most difficult contaminants to control at the source. When smoking is allowed, the amount of outdoor air provided should be 20 cfm per person. Areas that are nonsmoking areas may be supplied at the lower rate (5 cfm/person), provided that the air is not recirculated from, or otherwise enters from, the smoking areas(B).

VI. RESULTS/DISCUSSION

Fresh Air Adequacy

The building has 55 air handlers designed to supply at least 1.5 million CFM of air which is then introduced primarily through the ceilings of the offices. The system is designed to provide a minimum of 15% fresh air during work hours. Therefore, a designed minimum of 60 CFM/person (average) of fresh air is currently being furnished to the 3600 occupants, according to the ventilation specifications provided by DOL facilities managers. ASHRAE recommends a minimum of 20 CFM/person.

Six CO_2 measurements taken at mid-afternoon in areas producing previous stuffy air complaints all indicated CO_2 levels of 500-600 ppm. Outdoor CO_2 concentrations at that time were about 500 ppm. These findings indicate that plenty of outside air was being supplied to these offices during the NIOSH visit, according to ASHRAE guidelines. These guidelines, which are based on average amounts of CO_2 generated by sedentary adults, indicate that indoor CO_2 levels would usually have to be over twice as high as outdoor CO_2 levels before the fresh air guideline of 20 cfm/person is infringed.

Carbon Monoxide

The I-395 tunnel is exhausted at the southwest corner of the roof and the parking garage exhausts are located at street level. Most of the fresh air intakes are on the sixth floor. At least 200 feet separates any of the intakes from the exhausts.

CO measurements taken by a DOL Industrial Hygienist using an Ecolyzer® in various office areas have ranged from 2-6 ppm since he began monitoring in December 1984. Detector tube readings in offices during the NIOSH visit were all less than 5 ppm in the afternoon. Outdoor CO concentrations at street level were a maximum of 5-6 ppm during the morning rush hour and less than 5 ppm at mid-afternoon.

VII. CONCLUSIONS/RECOMMENDATIONS

The present air handling system will be able to accommodate the planned additional office workers and still provide over twice the amount of fresh air recommended by ASHRAE, assuming the air is properly circulated to all office areas. The configuration of new offices with the "New Systems" furniture does not appear to impair proper air circulation. Nevertheless, CO_2 measurements are a useful indicator of "stuffy air" and should continue to be used to help evaluate such complaints. As a general rule, indoor CO_2 levels should not exceed twice the outdoor CO_2 concentration. If high CO_2 levels are found in any office area, the ventilation system for that area should be investigated.

No hazards from carbon monoxide exposure were found during the NIOSH visit. However, CO levels should continue to be monitored during periods of severe stagnant weather that can commonly occur in Washington DC, especially during the months of July and August. At these times outdoor CO levels exceeding 20 ppm may be possible during rush hour. If problems occur, it may be possible to minimize indoor CO levels by supplying more of the necessary amounts of outdoor air during non-rush hour periods while conversely using more recirculated air during rush hour periods.

VIII. REFERENCES

1. U.S. Department of Health and Human Services. The health consequences of smoking: cancer 1982, a report of the Surgeon General. Washington, D.C.: U.S. Department of Health and Human Services, 1982.

2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. ASHRAE standard 62-1981, Ventilation for Acceptable Indoor Air Quality. Atlanta, Georgia: ASHRAC, 1981.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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1. U.S. Department of Labor
2. AFGE, Local 12
3. NIOSH, Region III
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