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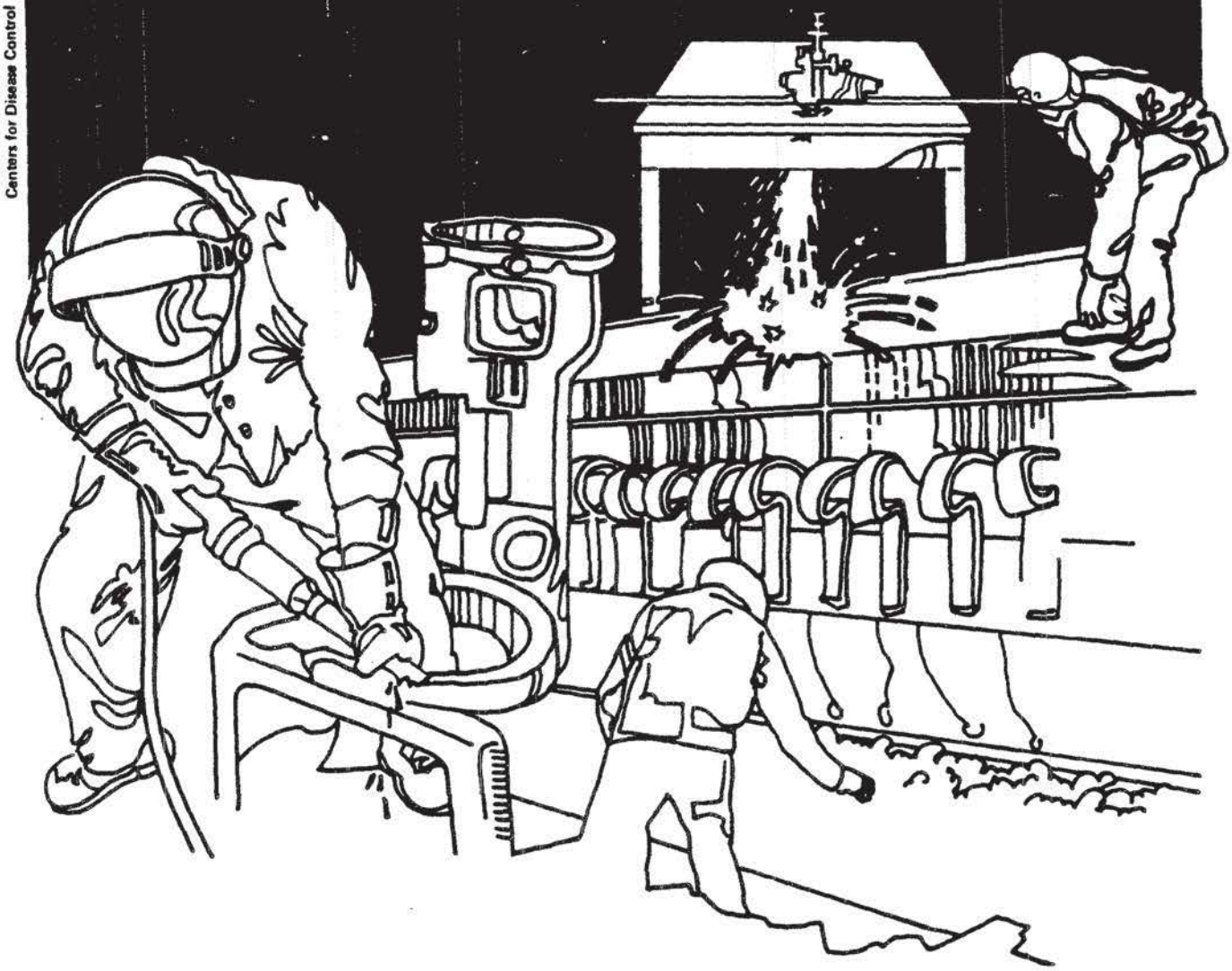

Health Hazard Evaluation Report

HETA 82-247-1280
BLUE CROSS OF
NORTHERN CALIFORNIA
OAKLAND, CALIFORNIA

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 nygiene 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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BLUE CROSS OF NORTHERN CALIFORNIA
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I. SUMMARY

In May 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the Office and Professional Employees Union, Local #29, to evaluate the possible relationship between complaints of headaches, respiratory illnesses and general discomfort and general air quality at Blue Cross of Northern California, Oakland, California.

On November 22, 1982, NIOSH investigators made a site visit to the building, reviewed the findings of a previous evaluation, interviewed workers, and reviewed data concerning the ventilation system.

In the previous evaluation, measurements had been made for carbon monoxide (CO) in the parking garage and in various office areas. CO levels were less than 5 parts per million (ppm) in the offices and 10 ppm in the garage. These levels were well within the NIOSH recommended limit of 35 ppm. The insulation material in the air-conditioning plenum was analyzed for fibrous glass (a possible irritant and was found not to contain fibrous glass. Also, fiber samples were collected in the plenums on two floors, and the fiber counts were less than 0.003 fibers/cc and were identified as cellulose material. Illumination measurements were made; lighting levels ranged from 30 - 110 foot-candles. For general reading tasks, 70 - 100 foot-candles are recommended, whereas video display terminals (VDT's) require lower illumination levels. Therefore, lighting problems can occur at work stations where both tasks are necessary. In general, employees were working at VDT work stations under conditions which did not meet many of the recommended ergonomic criteria cited in the NIOSH Research Report, "Health Hazards of Video Display Terminals." Micro-organism levels in the cooling tower water were measured and found to be low. The total plate count was 1.5×10^4 and the total yeast, total mold, gram negative and staphylococcus per gram counts were all less than 10. The previous evaluation report recommended that air sampling for formaldehyde, oxides of nitrogen, and total hydrocarbons might be necessary. NIOSH investigators felt that there was no evidence to suspect these contaminants were causing the complaints, and no further air samples were taken.

Evaluation of the ventilation system indicated that an energy saving program was instituted for 2 - 9 minutes per hour when the main system was turned off and the auxilliary induction system only was in operation. During this time period, the outdoor air requirements as recommended in the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) in their standard for indoor air quality were not met on eight floors. When the main system operates, the ASHRAE standard is met. The AHSRAE standard is 20 cubic feet per minute (CFM) per person when cigarette smoking is allowed. The workers' symptoms were reported to be exacerbated during this energy conservation period as work stations are in close proximity with smokers and non-smokers mixed together.

Based on the results of NIOSH's survey where irritation symptoms were documented, NIOSH concluded that there was a potential health hazard because of a combination of deficiencies in the ventilation system and the ergonomic design of the VDT work stations at Blue Cross. There was no evidence to suspect any air contaminant was causing the symptoms. Recommendations are made in Section VIII of this report to help in addressing the problems.

KEYWORDS: SIC 6324 (Hospital and Medical Service Plans), respiratory irritation, headache, ventilation, video display terminals, indoor air pollution, office buildings, ASHRAE, illumination

II. INTRODUCTION

In May 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Office and Professional Employees Union, Local #29, Emeryville, California, concerning worker complaints of eye irritation, upper respiratory irritation, and headache at the Blue Cross of Northern California office building in Oakland, California. The complaints have persisted since the building was first occupied in January 1973, but they increased during the Spring of 1982. The increase prompted the Union to submit a Health Hazard Evaluation (HHE) request to NIOSH and the management of Blue Cross to contract with a private consulting firm to conduct an industrial hygiene survey of the building. The firm conducted several surveys in the building, which resulted in three reports. At the request of the management, NIOSH delayed its investigation until all of the reports from the firm had been completed. On November 22, 1982, a NIOSH Medical Officer and Industrial Hygienist conducted a walk-through survey of the Blue Cross building and reviewed the available information from the consulting firm's reports. On January 6, 1983, a separate investigation was conducted by a physician and industrial hygienist from the California Occupational Safety and Health Administration (CAL/OSHA) in response to a complaint concerning video display terminals (VDT's). CAL/OSHA conducted a complete health and safety inspection which resulted in two safety citations. No citations of an industrial hygiene nature were issued. CAL/OSHA issued two information memos on VDT's and ventilation to Blue Cross, and the case has been closed. On the basis of all available information, it was judged by NIOSH that environmental contaminants would not be present in sufficient amounts to present a health hazard, but that ventilation deficiencies and/or ergonomic problems arising from the use of VDT's may be causing some of the problems being experienced by the employees. Some of the ventilation recommendations made by the consulting firm had been implemented prior to the NIOSH visit. Several general recommendations are made by NIOSH in the Recommendation Section of this report.

III. BACKGROUND

Approximately 1,500 employees work within the Blue Cross of Northern California building, including employees of American Presidential Lines which occupies six floors of the building. Most of the workers of Blue Cross process claims and are seated at open work stations in close proximity (6-9 feet) to other employees. The room volume of an average floor in the building is approximately 135,000 cubic feet. The number of employees on a typical floor ranges from less than 100 to 138. There are several air handling systems servicing the ventilation of the building. The main floors of concern are the second through the twentieth. Each of these floors are handled by two air systems. An induction system feeds tempered air at floor level on the east and west sides of the floor. This system is designed to provide 2,000 cubic feet per minute (CFM) of outside air at all times. The main ventilation system for a floor provides recirculated air at the middle sections of each floor. Approximately 10,000 CFM is provided by the main system of which 20% is designed to be outside air. This air is provided and removed via a series of special light fixture diffusers located throughout the ceiling. The main air handling system has not been balanced since it was first installed in 1972.

Because of energy conservation measures, the main air moving system is turned off for a period of 7 - 9 minutes per hour. The induction system providing the 2,000 CFM of outside air remains in operation. During this time period, many of the workers feel that there is insufficient ventilation in the workplace.

The industrial hygiene surveys that were conducted by the private consulting firm identified a series of potential problem areas in the ventilation, air quality, and lighting of the building. Although the final reports had not been available to NIOSH until immediately prior to the site visit, all of the problem areas had been discussed with the building engineers, and several changes had been made before the NIOSH visit. Additionally, certain environmental tests that were conducted for contaminants ruled out these agents as the probable cause of the problems being experienced by employees.

Carbon monoxide levels were measured on several floors and were less than 5 parts per million (ppm). The carbon monoxide level in the garage was measured at 10 ppm. All of these levels were well below the NIOSH recommended exposure limit of 35 ppm (based on a 10-hour time-weighted average). The temperature and relative humidity were measured, and both indices were within the Comfort Range (temperature 72°F - 80° F and relative humidity 20 - 80 %) recommended by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc (ASHRAE). The temperatures ranged from 74 - 78°F and the relative humidity ranged from 44 - 55%. The insulation material in the return air plenum was tested to determine whether it contained any fibrous glass. Management had an outside laboratory conduct a bulk sample analysis of the insulation material and also take several air samples in the plenums of the sixth and seventeenth floors. The material did not contain fibrous glass. Also, the air samples showed fiber counts less than 0.003 fibers/cubic centimeters of air. The fibers present were characterized as cellulose material. The water in the cooling tower for the air-conditioning system was checked for microbial or chemical contaminants. These tests were negative. The total microbial plate count was 1.5×10^4 per gram. This count was not excessive. The total yeast count per gram was less than 10. The total mold count per gram was less than 10. The gram negative count per gram and the staphylococcus count per gram were also less than 10. These values were not excessive.

One change was made in part of the ventilation system. The entire main tower of the building is interconnected by a vertical main shaft which allows for passive air movement between all levels. The consulting firm recommended that a fan be placed in the shaft to keep it under slight negative pressure. The plant engineer removed an obstruction in the shaft which took care of the air movement problem. The consulting firm also recommended taking air samples for various chemical contaminants that could cause irritation. At this time, no samples have been taken.

Lighting was measured in a number of different work areas by the consulting firm. Illumination levels ranged from 30 to 110 foot-candles. Because illumination levels of 70 to 100 foot-candles are necessary for most reading tasks, this apparent inadequacy may be contributing to problems that were reported by workers. Approximately 500 workers at Blue Cross use video display terminals, frequently without glare screens. At work stations with suffcient light for ordinary reading, the illumination levels create glare from the VDT's which can result in problems of eye strain, headache, and fatigue. At work stations with insufficient lighting for ordinary reading, glare is not a problem, but eye strain, headache, and fatigue can also result because of the insufficient lighting for the reading tasks.

IV. METHODS AND MATERIALS

A. Environmental

Since both private consultants and governmental agencies have conducted investigations in the Blue Cross building, it was decided to confine the NIOSH environmental portion of the study to a walk-through survey and an evaluation of the existing information and data. If there was a reason to conduct any further environmental sampling, it would be done at a future time. Also, the specifications of the ventilation systems would be reviewed and compared with ASHRAE's recommendations as cited in the ASHRAE Standard: "Ventilation for Acceptable Indoor Air Quality."[1]

B. Medical

Workers were interviewed on four floors regarding symptoms, work station design, and the temporal pattern of symptoms with regard to ventilation changes including the installation of the Honeywell energy conservation system.

V. EVALUATION CRITERIA

A. Environmental

In Table 3 (Outdoor Air Requirements for Ventilation - Commercial Facilities) of the ASHRAE Standard, the amount of outdoor air per person where smoking is allowed is 20 CFM for office space. Since NIOSH did not conduct any environmental sampling study, specific criteria are not listed here.

B. Medical

1. Ventilation Deficiencies

Inadequate ventilation may result in uncomfortable temperatures and humidity, in the accumulation of unpleasant odors and chemical substances such as the particulates and acroleins of cigarette smoke in recycled air, and in failure to remove toxic vapors and gases produced by work processes. The symptoms of employees working in areas inadequately ventilated will vary with the exposures which result from each of these types of problems. When toxic vapors and gases are not produced by a work process in the building, the most frequent ventilation problem is the accumulation of odors and chemical substances from cigarette smoking or from building and furnishing materials which may off-gas low levels of formaldehyde.

The symptoms found among workers in such situations may include (1) eye irritation, (2) upper respiratory irritation (dry nose and throat, frequent dry cough, sneezing), (3) more frequent or prolonged upper respiratory infections (colds), and (4) headache, irritability, and excessive fatigue. All of these symptoms are non-specific, that is, each could be the result of many different (and not work-related) causes. It is difficult, and often impossible, to determine the cause of such symptoms for one individual, but when a group of workers experience these symptoms, the association with poor ventilation is more easily recognized. While there are no known long-term health effects of such exposures, the effect of chronic symptoms of irritation, headache and fatigue can be very debilitating.[2]

2. Ergonomic Aspects of the Use of Video Display Terminals

In a NIOSH Research Report, "Potential Health Hazards of Video Display Terminals,"[3] the ergonomic evaluation of VDT operators concentrated on three aspects of the work environment: illumination, display legibility, and work station design. Although the reference treats each aspect separately, they are interactive with job task demands. In fact, recommendations are given as ranges instead of a single numerical value since there are differences in job tasks. Proper illumination is essential so that both the VDT screen and the hard copy can be read without visual discomfort or fatigue. Other aspects of illumination affecting the VDT operator are horizontal illuminance on the screen, extreme contrasts within the operator's field of vision between the materials being read and other sources of high illuminance, and direct discomfort glare from such sources as open windows and light fixtures with very high luminance levels. It has been shown that there is a relationship between display legibility and visual fatigue. Flickering on the screen and blurring of characters might cause problems. Also, reflected glare can also impact upon display legibility. Four factors concerning work station design are important. These are keyboard height, viewing distance, viewing angle, and chair features.

VI. RESULTS

A. Environmental

The private consulting firm looked at several environmental factors and the results were not significant. A recommendation was made to conduct air sampling for several air contaminants such as formaldehyde, oxides of nitrogen, and total hydrocarbons in addition to the parameters already measured. However, it was decided by management at Blue Cross not to sample for these contaminants. During NIOSH's walk-through survey of Blue Cross, it was decided by the NIOSH investigators that these contaminants would not be present in significant amounts and that sampling was not necessary. Numerous studies by NIOSH in office buildings where no major industrial processes were present failed to find these contaminants in significant levels.

The ventilation system specifications for the main system were obtained from the plant engineer for floors 1 - 20. The data is outlined in the following table:

Floor	Volume of Floor(Cubic Feet)	Air Flow(Cubic Feet/Minute)	No. of Workers
1	193,567	9,372	75
2	142,857	13,648	34
3	135,207	10,641	104
4	134,676	9,841	130
5	133,587	10,371	138
6	134,667	9,587	96
7	134,667	9,565	125
8	134,289	10,223	105
15	131,931	10,621	121
16	138,141	10,394	119
17	138,141	10,221	107
18	138,141	10,451	83
19	138,141	10,710	70
20	138,141	10,706	89

The summary table does not include floors 9 - 14 which are occupied by a tenant. Also, each floor except for the first floor has a separate induction ventilation system which provides continuous outdoor air at a rate of 2,000 CFM. Of the total amount of air flow per floor listed in the table, 20% of the total is outdoor make-up air. The ASHRAE Standard recommends 20 CFM per person of outdoor air when cigarette smoking is permitted. The following table contains the calculations of outdoor air per person at Blue Cross with both ventilation systems operating and just when the Honeywell energy saving system operates:

Floor	Outdoor Air = 20% of Main System(CFM)	Induction System + 20% of Main(CFM)	#People	CFM/Person (both systems)	CFM/Person (Honeywell Only)
2	2,729	+ 2,000 = 4,729	34	139.1	58.8
3	2,128	" = 4,128	104	39.7	19.2
4	1,968	" = 3,968	130	30.5	15.4
5	2,074	" = 4,074	138	29.5	14.5
6	1,917	" = 3,917	96	40.8	20.8
7	1,913	" = 3,913	125	31.3	16.0
8	2,044	" = 4,044	105	38.5	19.1
15	2,124	" = 4,124	121	34.1	16.5
16	2,078	" = 4,078	119	34.3	16.8
17	2,044	" = 4,044	107	37.8	18.7
18	2,090	" = 4,090	83	49.3	24.1
19	2,142	" = 4,142	70	59.2	28.6
20	2,141	" = 4,141	89	46.5	22.5

The CFM per person when the entire ventilation system is in operation ranges from 29.5 - 139.1. Thus, in relation to the ASHRAE Standard of 20 CFM per person, all the floors showed values well above this criteria. However, during the seven to nine minutes per hour that the Honeywell energy saving system is in operation, eight of the floors (3,4,5,7,8,15,16,17) drop below the criteria. These calculations are based on 2,000 CFM which is the rated air flow of the induction system.

B. Medical

Symptoms of upper respiratory irritation and headache were reported by the majority of workers interviewed. Symptoms were temporally related to work in the building, and were exacerbated by the nine minute period during which no fresh air was provided from the main system. Workers noted particularly the problems of crowded work stations, creating a crowded microenvironment with high stress, in some cases made worse by mixing of smokers with non-smokers. Also, workers reported eye strain and musculoskeletal complaints related to the use of VDT's.

VII. DISCUSSION AND CONCLUSIONS

Based on the available information, the symptoms reported by the workers were consistent with inadequate ventilation, with overcrowding, and with poor design of VDT work stations. No environmental contaminant was suspected of causing any of the symptoms. No further environmental air samples will be collected, at this time, by NIOSH, private consultants, or CAL/OSHA.

VIII. RECOMMENDATIONS

The following recommendations are made to improve the general work environment at the Blue Cross Building:

1) The Honeywell energy conservation system should be eliminated since the outdoor air levels fall below the ASHRAE Standard on eight floors.

2) The ventilation system for the building should be balanced by a mechanical engineering firm since it has not been serviced since it was installed.

3) The video display terminal work stations should be redesigned to address such problem areas as glare, lighting, and other ergonomic factors which are detailed in the NIOSH research report.[3]

4) Consideration should be given to separating smokers and non-smokers in the work areas.

IX. REFERENCES

1. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc: ASHRAE Standard (62-1981) Ventilation for Acceptable Indoor Air Quality, 1981.

2. Kreiss, K: Building-Associated Epidemics in Indoor Air Quality, Walsh, P.J. and C.S. Budney, eds., Boca Raton, CRC Press, 1983 (in press).

3. U.S. Department of Health and Human Services (NIOSH): "Potential Health Hazards of Video Display Terminals," Publication No. 81-129, June, 1981.

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XI. DISTRIBUTION AND AVAILABILITY

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Copies of this report have been sent to:

1. Blue Cross of Northern California
2. Local #29, Office and Professional Employees Union
3. NIOSH - Region IX
4. U.S. Department of Labor - Region IX
5. State Designated Agency - CAL/OSHA
6. California Department of Health Services.

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