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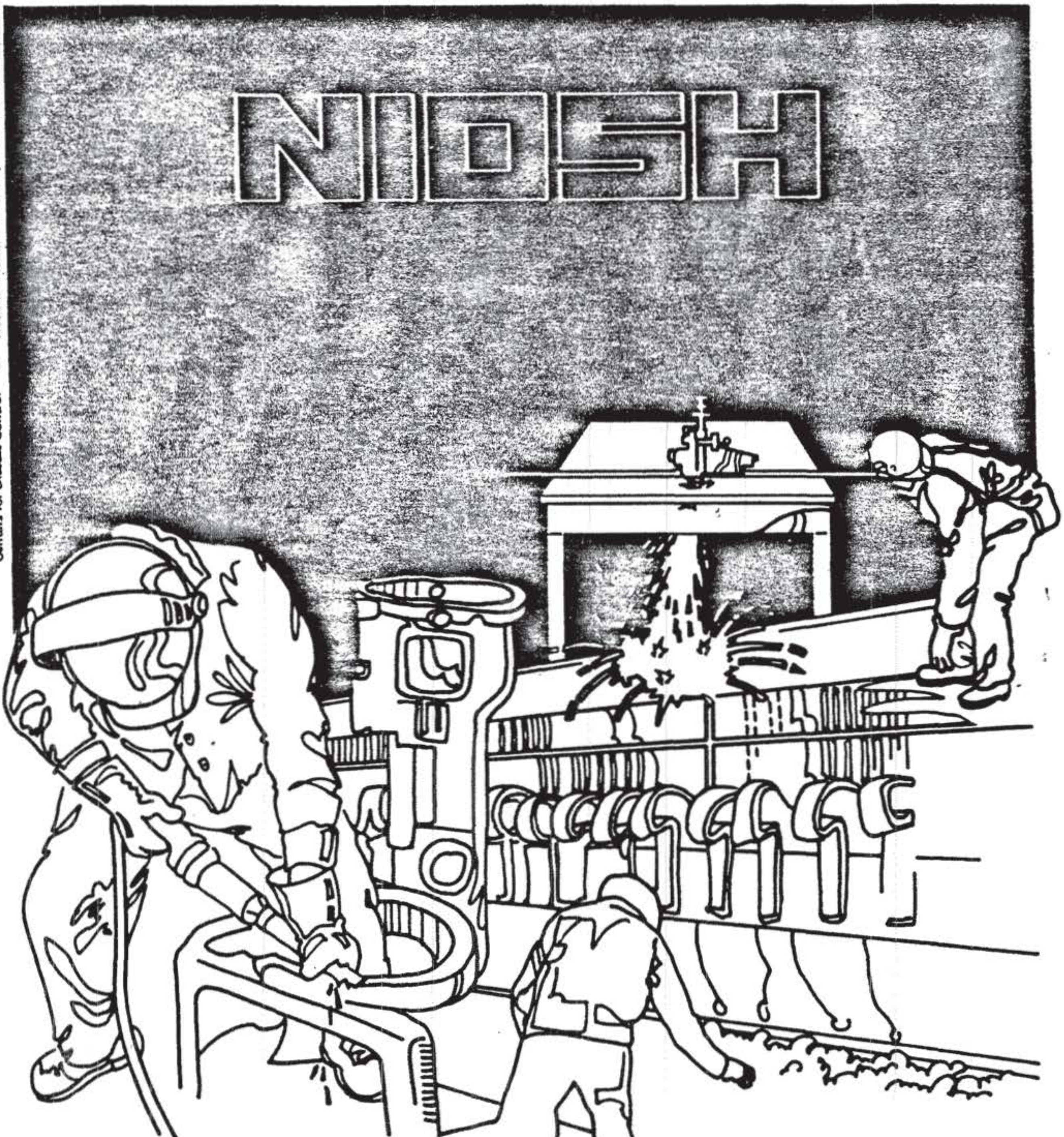

Health Hazard Evaluation Report

HETA 82-238-1134
OHIO BELL
BOARDMAN, OHIO

DEPA

NATIO

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.

HETA 82-238-1134
June 1982
OHIO BELL
BOARDMAN, OHIO

NIOSH INVESTIGATORS:
Steven H. Ahrenholz, I.H.
Peter A. Boxer, M.D.

I. SUMMARY

On April 26, 1982, the National Institute for Occupational Safety and Health (NIOSH) was requested by Ohio Bell to conduct an investigation of conditions at the Boardman, Ohio switching office to determine the cause of upper respiratory irritation being experienced by the workers at the facility.

The office houses switching equipment and subscriber service connections for the Ohio Bell telephone system. Ohio Bell is the sole occupant of the single story concrete building.

On April 29, 1982, NIOSH conducted an environmental and medical evaluation of the switching office which included environmental assessment of humidity and selected irritants. Relative humidity readings were obtained with a psychron, irritants were evaluated with detector tubes, and ozone was sampled by an impinger method. A questionnaire to determine the frequency of adverse health effects was administered to all six current employees at the switching office and to two employees transferred out of the office during the past month. The questionnaire contained questions pertaining to demographic information, medical history (including allergies), occupational history, and adverse health effects which might result from excessive exposure to ozone or from working in an environment with inadequate humidity.

Relative humidity levels in the office averaged 15% (12-17%). A range of 30-60% relative humidity is recommended by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers. Carbon monoxide, formaldehyde, hydrocarbons, and oxides of nitrogen were not detected. All detected ozone levels were 0.02 ppm (0.04 mg/m^3). This was below the OSHA standard for ozone of 0.1 ppm (0.2 mg/m^3).

The most frequent symptoms reported were dryness or soreness of the nose and throat, and nasal, sinus congestion. The fact that these symptoms resolved when employees were away from work for several days, and promptly recurred after returning to work lends support to an environmental etiology.

Based on the information obtained during the survey, NIOSH determined that employees were exposed to exceptionally dry conditions which could contribute to upper respiratory irritation. Health effects reported were those compatible with the effects of very low humidity. Ozone levels were low and did not represent a health hazard. A recommendation is made to install a humidification unit in the ventilation system.

KEYWORDS: SIC 4811 [Telephone Communication (Wire or Radio)] humidity, ozone, office environment, respiratory irritation

II. INTRODUCTION

On April 26, 1982 the National Institute for Occupational Safety and Health (NIOSH) received a request from Ohio Bell to conduct a Health Hazard Evaluation at their Boardman, Ohio switching office. The request expressed concern about upper respiratory irritation among workers and sought an investigation of the office for possible causative factors.

On April 29, 1982, NIOSH investigators conducted a survey at the switching office. Employee representation was provided by Local 4300 of the Communication Workers of America.

III. BACKGROUND

The Ohio Bell Switching Office in Boardman , Ohio occupies a single story windowless building constructed of concrete block, brick, and poured cement building measuring 18 by 37.5 meters (60 by 123 feet). The original facility was constructed in 1956 with additions in 1965 and 1974. Ohio Bell is the sole occupant of the building which houses telephone switching and test equipment (all located on the first floor). A diesel-powered emergency generator and storage batteries, and the cable vault are located in the basement.

The building is heated by a gas fired system utilizing convection type heat registers. Ventilation is provided by two separate air handling units. One unit serves the basement areas (except the workers' lounge) and the other, larger unit provides ventilation to the first floor equipment areas and lounge. Both units have thermostatically operated dampers on the air intakes and discharges. Air conditioning equipment is incorporated into the larger ventilation unit. All air taken into this unit serving the first floor passes through two types of dust filters. The generation of heat by the switching equipment results in a significant amount of waste heat, thus the ventilation system is set to maintain building temperature at about 24°C (75°F). No humidification equipment is present in the building.

Six employees work in the office. Two are apparatus technicians, involved with wiring, testing, and troubleshooting of equipment. Three are central office technicians involved in testing, locating and clearing electrical faults, analyzing equipment status reports and advising maintenance personnel; conducting preventive maintenance; and testing electronic switching system equipment. Additionally the central office technicians are capable of working on any of the other equipment present in the office. The assistant manager is assigned supervisory duties for this and three other similar offices.

Chemical use in the office is limited to cleaning products, a white rosin core solder, and a bank cleaning fluid used for cleaning contacts in the switching equipment.

IV. METHODS AND MATERIALS

Evaluation of environmental conditions at the Ohio Bell Switching Office involved both industrial hygiene measurements for potential irritants and the administration of questionnaires to all present and recently transferred workers concerning the reported health effects.

A. Environmental

Direct reading indicator tubes were used to measure airborne concentrations of carbon monoxide (CO), carbon dioxide (CO_2), formaldehyde, hydrocarbons, oxides of nitrogen (NO_x), and ozone (O_3). Substances sampled were selected on the basis of potential irritants associated with building materials and the occurrence of small electric arcs in switching equipment. Ozone had also been indicated as a possible contaminant by the requestor. The lowest concentrations which could be read for the respective indicator tubes were: CO - 5 parts per million (ppm); CO_2 - 1% or 10,000 ppm; formaldehyde - 0.5 ppm; hydrocarbons - determined by number of strokes required to produce discoloration and the specified hydrocarbon (eg. butane, propane); NO_x - 0.5 ppm; and O_3 - 0.025 ppm. The number of pump strokes for O_3 was increased from 10 to 20 to permit greater sensitivity of the tube.

Area ozone samples were also obtained using NIOSH Method P&CAM 154[1] which involves drawing air at 1 liter per minute through an alkaline potassium iodide solution contained in a midget impinger. Ozone levels were suspected to be low; therefore, sampling time was increased from 45 minutes to about 90 minutes which resulted in a 90 instead of a 45 liter air sample. Concentrations of ozone collected are determined spectrophotometrically. The limit of detection was reported to be 16 micrograms (ug) for impingers with a lower limit of quantitation of 80 ug per impinger. Since the reaction of ozone with alkaline potassium iodide is not quantitative and is concentration dependent, a correction equation specified in NIOSH Method P & CAM 154 was applied to the environmental concentrations after subtracting field blank values. Ozone sampling was conducted during the 2:30 to 4:30pm peak usage period. The other peak switching period was reportedly 10 to 11am.

Dry bulb and wet bulb temperatures were obtained at all sample locations and in several other areas of the building using a battery operated psychron.

A walk-through survey of the building was conducted focusing on potential sources of chemical irritants. The ventilation system including the various air-conditioning components as well as the heating system were visually inspected to determine its potential for contribution to the problem of dryness and mucous membrane irritation.

B. Medical

A questionnaire was administered to all six current employees at the switching office and to two employees who had transferred to different offices within the past month. The questionnaire contained questions pertaining to demographic information, medical history (including allergies), occupational history, and adverse health effects from excessive exposure to ozone or from working in an environment with low humidity. Included were questions pertaining to headache; nausea or vomiting; dizziness; dryness or soreness of nose/throat; sinus congestion; eye irritation; drowsiness; cough; shortness of breath; chest tightness; wheezing; nosebleeds; and skin problems.

V. EVALUATION CRITERIA

A. Ozone

The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) to ozone is 0.1 ppm (0.2 mg/m^3) for an eight hour time weighted average.[2]

Ozone is a colorless gas with a sharp, characteristic odor which can be detected by the sense of smell at concentrations below the PEL (beginning between 0.01 to 0.05 ppm, 0.02 to 0.09 mg/m^3). Ozone spontaneously decomposes under normal atmospheric conditions and would generally be encountered only in the immediate vicinity of its formation.[3] The decomposition of ozone is speeded by solid surfaces and catalyzed by a number of agents including moisture, certain heavy metal, such as platinum and silver and certain metal oxides. Nitrogen pentoxide and the halogens also accelerate ozone decomposition.[4]

Exposure to excessive levels of ozone produces acute symptoms, including irritation of eyes, nose and throat, and cough. Higher ozone concentrations can lead to headache, upset stomach, vomiting, chest tightness or pain, and shortness of breath. Daily intermittent exposure to ozone concentrations over 5 ppm may result in incapacitating pulmonary congestion. While chronic pulmonary changes after long-term exposure to ozone have been reported in animal experiments, these effects have not been demonstrated in humans.

B. Humidity

The majority of references addressing temperature and humidity levels as they pertain to human health frequently appear in the context of assessing conditions in hot environments. Development of a "comfort" chart by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers presents a comfort zone considered to be both comfortable and healthful. This zone lies between 73 and 77°F (23 and 25°C) and 20 to 60 percent relative humidity. Recommended design conditions are an effective temperature and dry bulb temperature of 76°F (24.5°C), a relative humidity of 40 percent, and an air circulation rate of less than 45 feet per minute.[5] Effective temperature is an index of relative comfort determined by successive comparisons of individuals to different combinations of temperature, humidity, and air movement.[6] Relative humidity levels below 30 percent are associated with increased discomfort and drying of the mucous membranes.[5]

VI. RESULTS

A. Industrial Hygiene

The only finding considered potentially responsible for the dryness and irritation experienced by workers was the extremely low relative humidity present in the building. Dry bulb temperatures averaged 78 $\pm$ 2.4°F (26 $\pm$ 1.3°C) on the date of the survey. Relative humidity levels averaged 15 $\pm$ 3.1%. (Values calculated to 95% confidence interval). Table I presents the measurements obtained by location.

Detector tube readings for CO, formaldehyde, hydrocarbons and NO_x were all below the respective tubes' limit of detection. Carbon dioxide levels were detected by a small amount of color change but the length of stain on the tube could not be read quantitatively. Detector tubes for ozone indicated a length of stain less than or equal to about 0.025 ppm (0.05 milligrams per cubic meter or mg/m^3). Interferences on the ozone tube due to NO_x (indicated as negligible by detector tubes) and chlorine (absence of source) were not considered likely.

No difference was noted among the ozone detector tube values obtained at the four different sampling locations. The interpretation of the low detector tube values should be used basically as a guide in determining the presence of a specified compound at low levels. The best accuracy which can be expected for these type of measurements is in the range of $\pm$ 25 to 35 percent. Assignment of specific values to readings obtained below the calibration scale may be subject to significantly greater error.

Ozone samples obtained for the same locations using impingers containing a sampling reagent resulted in five of six values at 0.04 mg/m^3. The sixth value was below 0.04 mg/m^3, the environmental limit of quantification for that particular sample. Generally the ozone concentrations present were near the limits of quantitation. Ozone sampling data is presented in Table II.

B. Medical

The job titles of the employees were as follows: apparatus technician (2), central office technician (3), and assistant manager (3). Two of the managers no longer work at the office under study. The mean age of the eight employees was 46 years (Range 32-55). Four employees were male, two were female. The median number of years working at the switching office was four years (range 2 weeks - 25 years).

Five employees reported having symptoms that were either entirely new or had been experienced more frequently since they started work at the switching office. Symptoms reported, and the number of employees reporting them, were as follows: headache (1); dryness or soreness of nose or throat (5); minor eye irritation (2); nasal, sinus congestion (5); drowsiness (1); cough (2); wheezing (1); and dry skin (2). Two employees reported nosebleeds, but further questioning revealed that in two cases these actually were episodes of blood-tinged mucous rather than frank bleeding. No employees reported nausea, vomiting, dizziness, shortness of breath, or chest tightness or pain.

Onset of symptoms was between six months and two years ago. All affected employees reported that symptoms were most severe during winter, although they were present year-round. All also reported that symptoms markedly decreased when they were away from the office for several days. Workers who rotated between switching offices reported that they were asymptomatic while working at other locations, but symptoms promptly recurred after they returned to the switching office under study.

None of the employees had ever noted the characteristic pungent odor of ozone in the office. It was generally felt that the air in the office was unusually dry, and that a makeshift attempt to increase the humidity in the air by using buckets of water was somewhat successful in relieving their symptoms.

VII. DISCUSSION AND CONCLUSION

The NIOSH survey did not identify any specific health hazard to workers of the switching office but did reveal a condition of exceptionally low relative humidity which may have an effect on worker health and comfort. The switching equipment is not particularly sensitive to humidity, and therefore, does not require any specific level of humidification as is required by more advanced electronic components. Nevertheless this should not negate the requirements of the human components in the system.

Workers reported that symptoms associated with low humidity were not as severe when buckets filled with water and having mop heads acting as wicks were placed in the air return chamber preceeding the air supply fan. Ohio Bell representatives verified that plans and provisions were being made to install a system humidifier this coming fall.

An additional benefit of increasing humidity levels inside the office is that this would be expected to reduce further any ozone levels which are generated by existing equipment. No problem with ozone was documented, but the fact that moisture catalyzes the decomposition of oaone should assist in keeping levels very low.

Ozone levels in the switching office averaged 20 percent of the OSHA standard. Although the OSHA standard of 0.1 ppm (0.2 mg/m^3) is to be applied to an eight hour period, the values obtained during a peak operation period on the day of the survey and the generally continuous nature of the operation do not indicate that ozone exposure is a problem.

The most frequent symptoms reported were dryness or soreness of the nose and throat, and nasal, sinus congestion. The fact that these symptoms resolved when employees were away from work for several days, and promptly recurred after the employees returned to work, lends support to an occupational etiology. No employees reported ever smelling the pungent odor of ozone. Measured ozone levels did not exceed permissible limits. Thus it is unlikely that excessive exposure to ozone caused the symptoms reported. These symptoms are compatible with the effect of very low humidity. The fact that humidity readings taken by NIOSH were "very low" and that a previous attempt to increase humidity had decreased the severity of the symptoms suggests that insufficient humidity was responsible for the upper respiratory irritation experienced by employees at the switching office.

VII. RECOMMENDATIONS

The addition of a humidification unit to the ventilation system is recommended to prevent the respiratory irritant effects experienced by workers. Relative humidity levels should be maintained between 30 and 60 percent.

VIII. REFERENCES

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by: Steven H. Ahrenholz
Industrial Hygienist
Industrial Hygiene Section

Peter A. Boxer, M.D.
Medical Officer
Medical Section

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

Report Typed By: Betty L. Widener
Clerk-Typist
Industrial Hygiene Section

X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Ohio Bell, Columbus, Ohio
2. Local 4300 of the Communication Workers of America, Youngstown, Ohio
3. NIOSH, Region V
4. OSHA, Region V

For the purpose of informing the six 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.

TABLE I

TEMPERATURE AND HUMIDITY READINGS
Ohio Bell Switching Office
Boardman, Ohio
HETA 82-238

March 29, 1982

LOCATION	TEMPERATURE-°F				RELATIVE HUMIDITY	
	Dry Bulb		Wet Bulb		%	
	am	pm	am	pm	am	pm
Special Services Desk (NW area)	77	78	53	53	15	14
Intermediate Distribution Frame (W side)	79	79	53	54	12	15
Step-by-Step Equipment (SE corner)	78	79	54	54	17	15
Step-by-Step Equipment (E center-aisle 16R & 17L)	78	78	53	53	14	14
Basement Lounge	--	79	--	53	--	18
Basement Power Room	--	79	--	54	--	15
General Basement Area	--	77	--	53	--	15

Barometric pressure: 761 mmHg

TABLE II

OZONE CONCENTRATIONS
Ohio Bell Switching Office
Boardman, Ohio
HETA 82-238

March 29, 1982

LOCATION	OZONE CONCENTRATIONS IN ppm AND (mg/m^3)*		
		IMPINGER	
	DETECTOR TUBE**	CONCENTRATION	DURATION (minutes)
Special Services Desk (NW area)	< 0.02 (0.05)	0.02 (0.04)	94
		0.02 (0.04)	65
Intermediate Distribution Frame (W side)	< 0.02 (0.05)	0.02 (0.04)	101
Step-by-Step Equipment (SE Corner)	< 0.02 (0.05)	0.02 (0.04)	88
		NQ***	54
Step-by-Step Equipment (E center-aisle 16R & 17L)	< 0.02 (0.05)	0.02 (0.04)	90

OSHA Permissible Exposure Limit: 0.1 ppm ($0.2 mg/m^3$)

* ppm = parts per million, mg/m^3 = milligrams per meter cubed; L = liters
** mg/m^3 value obtained by using 0.025 ppm in calculation. 0.02 obtained due to rounding. < indicates less than. Ozone identified as present but read from bottom end of scale.
*** NQ = ozone was detected but was not present in sufficient quantity to determine an amount; This was the shortest sample in duration (54 minutes, 54 liters).

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