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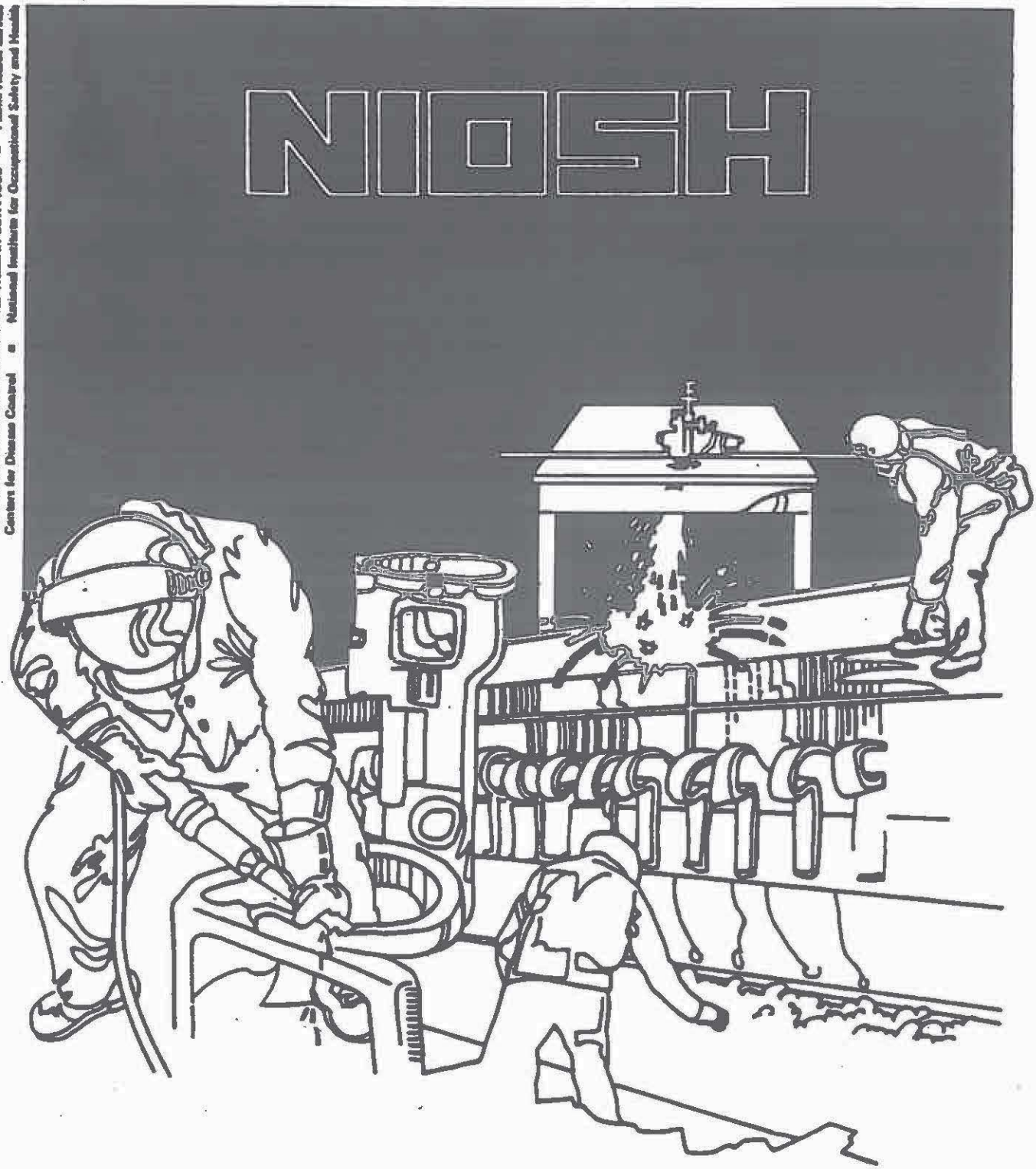

Health Hazard Evaluation Report

HETA 84-534-1721
DEFENSE INDUSTRIAL SUPPLY CENTER
PHILADELPHIA, PENNSYLVANIA

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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

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I. SUMMARY

On September 25, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the management of the Defense Industrial Supply Center (DIS), Philadelphia, Pennsylvania. The request concerned complaints of respiratory problems and possible excess cancer-related deaths in A and B Sections of Building 3.

A visit was made to the DIS on December 6-7, 1984, for a walk-through evaluation by a NIOSH physician and an industrial hygienist. On December 7, 1984, the NIOSH industrial hygienist performed atmospheric evaluations for carbon monoxide, percent relative humidity (%RH) and temperature. Two carbon monoxide air samples were collected on long-term length of stain detector tubes in the ZC and computer B areas.

On January 21-22, 1985, environmental samples were collected and measurements made for carbon dioxide, temperature, %RH and organic vapors and airborne dust. The medical officer distributed questionnaires to every fifth person in the building, chosen from a personnel list after a random start.

Although the atmospheric air samples showed the levels of carbon monoxide (15 ppm) and carbon dioxide to be below the permissible OSHA and ACGIH limits, the carbon dioxide levels in certain areas (Table II) indicate that the amount of outside air being introduced into the building was in the range where occasional complaints of respiratory and mucous membrane problems, as well as headaches, may be caused. When the temperature is high, the CO levels were high enough for these complaints to become general. In addition, many of the individuals in these areas are cigarette smokers. ASHRAE recommends seven occupants per 1000 square feet for smoking areas. Due to a lack of space in the building, the occupancy is much higher in many areas. They also recommend that 20 cubic feet of outside air per occupant be supplied in areas where smoking is permitted.

All other contaminants (dust and organic vapors) were within the acceptable OSHA levels.

Very low relative humidity (as low as 17%) and high temperature (78.5°F) were measured. These levels can place the employees in a discomfort zone.

Over one-third of the employees interviewed stated that they had headaches, dry, sore throats, nasal congestion, and eye irritation repeatedly at work in Building 3. The following numbers of workers stated that they had experienced the following symptoms more frequently since starting work at DIS: fatigue, 51 (48%) of 107 who answered the question; flu, 33 (32%) of 102; muscle pain, 21 (21%) of 102. These problems may be related to the poor ventilation and temperature and humidity noted above; some part of these problems may also be related to poor lighting and to work on video display terminals.

Forty-nine names of Building 3 employees who possibly contracted or died of cancer in the last fifteen years were supplied by the union and by individuals. No medical files are kept at DIS, and no personnel information is kept on retirees. Therefore, sufficient data could be supplied on only five of these workers, and the state of Pennsylvania could locate death certificates for only three. There was no evidence of a cancer cluster of a rare cancer or cancers. Because of the lack of a complete listing of cancer victims, the lack of a denominator, and the lack of confirmation of diagnoses, it is impossible to say if the cancer rate in Building 3 or in the computer area is higher than the rate for the U.S. population.

Based on the information obtained during this survey, it has been determined that at the time of the survey potential hazards from poor ventilation, high temperature, and low humidity existed in Building 3 of Defense Industrial Supply. Recommendations for controlling these hazards are contained in Section VII of this report. Insufficient data was supplied to determine whether or not a higher rate of cancer existed at DIS than in the general U.S. population.

KEYWORDS: SIC 9451 office buildings, indoor air pollution, cancer, carbon dioxide, temperature, relative humidity.

II. INTRODUCTION

On September 25, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the management of the Defense Industrial Supply Center, Philadelphia, Pennsylvania. The request stated that there were complaints of respiratory problems and possible excess cancer-related deaths in A and B Sections of Building 3, which consist mainly of the computer, central communications, and data processing operations. No causative agent was given.

A visit was made to the Defense Industrial Supply Center on December 6-7, 1984, by a NIOSH physician and an industrial hygienist. Following an introductory meeting with labor and management representatives, a walk-through evaluation of the A and B areas of Building 3 was conducted. Samples of insulation, solvent cleaner and information on carbonless paper were collected during the walk-through. At this time the union asked that NIOSH include the C and D areas of the building in their evaluation; management and NIOSH agreed. The medical officer visited the personnel office to investigate possibilities of obtaining medical and other information on employees who had died.

On December 7, 1984, the NIOSH industrial hygienist measured carbon monoxide concentrations, percent relative humidity (%RH) and temperature. Two carbon monoxide air samples were collected on long-term length of stain detector tubes in the ZC and computer B areas.

On January 21-22, 1985, environmental samples were collected and measurements made for carbon dioxide, temperature, %RH and organic vapors and airborne dust. The medical officer distributed questionnaires to every fifth person in the building, chosen from a personnel list after a random start. The questionnaires were distributed to groups of 6-10, who filled them out at that time. The medical officer went over the answers with each person individually to resolve ambiguities or difficulties.

Interim letters were mailed to concerned parties on January 3, 1985, and March 15, 1985.

III. BACKGROUND

Defense Industrial Supply (DIS) is a military facility with civilian employees. Its buildings are within a compound administered by the Aviation Supply Office (ASO). DIS is under one military commander; the ASO, which supplies heating, ventilation, etc. to all the buildings of the compound including those of DIS, is under another.

Building 3 of DIS was converted from a warehouse to an office building in the early 1960s. The building was used for aircraft storage until the mid-fifties; after that, until the time of conversion, printed forms were stored in it. Approximately 600 people currently work in the building. Most of the employees in the building work chiefly in data processing.

Monitoring in the past has shown humidity as low as 15% in 1982 and 1983. Make up air in 1983 was reportedly as low as 10%. DIS has asked ASO for at least 30% make-up air but it is not certain whether or not ASO has complied with this request.

No chemical exposures are found in most areas of the building. An exception is in the computer/tape library area, where about six pints/week of tape drive cleaner is used. Currently this is a mixture of trichlorofluoroethane 65% and isopropyl alcohol. Pure isopropyl alcohol was reportedly used at some time in the past, but employees state that "something else was used in between." An effort to identify this other chemical through procurement forms and other methods was unsuccessful. Employees state that the gloves they wear during the tape cleaning process deteriorate while they are working and are not heavy enough. Printers, who also wear gloves, use a variety of inks such as "Dry Ink 9700" (Xerox) and Marsh Rollmark Roller Stencil Ink. In the microfiche area, an ammonia-based developer-fixer is used.

Recent air monitoring, according to the safety officer, has revealed metals and tars from cigarette smoke on the filters. It is planned to do air monitoring once per quarter.

IV. METHODS AND DESIGN

A. Environmental Design

Two carbon monoxide and nine carbon dioxide environmental air samples were collected at various locations in Building 3, on length of stain detector tubes with personal air sampling pumps operating at 20 cubic centimeters per minute (cc/M).

Three samples were collected for organic vapors on charcoal tubes and personal air sampling pumps operating at 200 cubic centimeters (cc) per minute. Since the major component of the bulk sample was diacentone alcohol, the air samples were analyzed for this contaminant. All concentrations were below the limit of detection 0.01 milligram per cubic meter of air sampled (mg/M^3). The Occupational Safety and Health Administration (OSHA) standard is 240 mg/M^3. Temperature and %RH determinations were made with a Bendix psychometer.

Airborne dust samples were collected on pre-weighed mixed cellulose membrane filters and analyzed gravimetrically. A bulk sample of the pipe covering was previously collected and showed no asbestos to be present.

B. Medical

On January 21-22, a questionnaire was administered to every fifth person (selected from a personnel list after a random start) in sections A, B, C, and D of Building 3. One hundred and twenty questionnaires were completed. Most of these questionnaires were lost in transit between Defense Industrial Supply and NIOSH. The union then redistributed blank copies of the questionnaire, and 108 people sent completed questionnaires individually to NIOSH. Because the list of original participants was also lost with the questionnaires, we do not know if the new questionnaires were filled out by people from the same sample who were interviewed originally.

The questionnaire focused chiefly on physical characteristics of the work area, type of work done, history of allergy, history of respiratory disease or of other diseases that might impair respiratory function, and respiratory, neurological, and dermatological conditions perceived as being related to work at DIS. A question on cancer, which is described below, was also asked.

Frequencies were calculated for employees in the overall workplace in Building 3. We planned to report frequencies for the individual work areas also, to look at whether certain complaints came primarily from any one area. However, most of the complaints were widespread and categorizing the data by individual areas did not show any significant differences between areas; therefore, only overall building 3 frequencies are reported. Unfortunately, many of the mailed questionnaires had some questions left blank. It is impossible to guess whether the questions were skipped because they were not considered relevant, or because their form was confusing and the non-responders did not know how to answer them. Frequencies are therefore reported as percentages of the numbers of those who answered each question; these numbers are noted.

The union gave the NIOSH investigators a list of 30 names of people who had contracted or died of cancer during or after the time of their work at DIS in the past 15 years. Nineteen additional names were obtained from the questionnaires, which asked "Have you ever known anyone who has worked in building 3 who has had any sort of cancer in the past 10 years? (Include yourself.)" The questionnaire asked for name, job title, dates of work in building 3, type of cancer, date of diagnosis, age at time of diagnosis, and outcome (if known).

Because no medical records are kept at DIS it was not possible to locate additional cancers through records. Personnel records are sent to a government record facility upon a person's retirement or termination, and are not filed by workplace; it is therefore impossible to recover files of former DIS employees. We could locate only five names still in the personnel files for which there was complete enough information to allow us to ask the Pennsylvania vital statistics office

for death certificates. (Pennsylvania requires a date of birth, or social security number, and the year of death). We therefore asked the State of Pennsylvania for these five certificates, and three certificates were returned.

V. ENVIRONMENTAL CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended exposure limits, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday.

Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

The primary sources of air contamination criteria generally consulted include: (1) NIOSH Criteria Documents and recommendations for occupational exposures, (2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's), (3) the U.S. Department of Labor (OSHA) federal occupational health standards, and (4) the indoor air quality standards developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). The first three sources provide environmental limits based on airborne concentrations of substances to which workers may be occupationally exposed in the workplace environment for 8 to 10 hours a day, 40 hours per week for a working lifetime without adverse health effects. The ASHRAE standards are general air quality standards for indoor environments, and are applicable for the general population exposed for up to a 24-hour day of continuous exposure without known toxic effects.

Indoor air should not contain concentrations of contaminants known to impair health, or to cause discomfort to a substantial majority of the occupants. Ambient air quality standards/guidelines available from federal, state, or local authorities should be consulted. If the air is thought to contain any other contaminants, reference to OSHA, ACGIH, and NIOSH recommendations should be made; for application to the general population, the concentration of these contaminants should not exceed 1/10 of the limits which are used in industry.

Several examples of common contaminants found in both industrial and non-industrial (indoor air) environments are shown below with their relevant environmental exposure criteria:

Contaminant	Concentration/Exposure Period 8-Hour TWA	Continuous	Source
Carbon monoxide (ppm)	50	---	OSHA/ACGIH
	35 (200^{C})	---	NIOSH
	---	9	ASHRAE
Formaldehyde (ppm)	3	---	OSHA
	CA	---	NIOSH
	---	0.1	ASHRAE
Total particulates (mg/m^3)	15	---	OSHA
	10	---	ACGIH
	---	0.26 (24-hr^{C})or 0.075 (1-yr mean)	ASHRAE
Asbestos (fibers/cc)	0.2	---	OSHA
	0.5--2	---	ACGIH
	CA	---	NIOSH
	---	CA	ASHRAE
Carbon dioxide (ppm)	5000	---	OSHA/ACGIH
	10,000	---	NIOSH

NOTE: ppm = parts of contaminant (gas or vapor) per million parts of air, by volume
mg/m^3 = milligrams of contaminant per cubic meter of air
CA = lowest feasible level (suspect or confirmed carcinogen), use best control technology
C = short-term (15-30 min) or ceiling limit

Other contaminants may be identified or suspect, dependent upon the particular situation and processes existing, and thus warrant further consideration.

Neither NIOSH nor the Occupational Safety and Health Administration (OSHA) have developed ventilation criteria for general offices. Criteria often used by design engineers are the guidelines published by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE). ASHRAE Standard 62-1981[1] provides ventilation requirement guidelines for a wide variety of commercial, institutional, and industrial facilities, including office buildings. This standard is based on an occupant density of seven persons per 1000 ft^2 of floor area, and recommends higher ventilation rates for areas where smoking is permitted. The standard states that indoor air quality for general offices shall be considered acceptable if the supply of outdoor air is sufficient to reduce CO_2 to less than 2500 ppm and 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 standard is 5 cubic feet per minute (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 comtaminants to control at the source. When smoking is allowed, the amount of outdoor air provided should at a minimum, be 20 CFM per person. Non-smoking areas may be supplied at the lower rate (5 CFM/person), provided the air is not recirculated from, or otherwise enters from, the smoking areas.[1]

Several studies have suggested that in occupied spaces a level of CO_2 in excess of 1000 ppm is an indicator of inadequate outdoor supply in HVAC system. Occupant discomfort results from build-up of numerous contaminants, including cigarette smoke, hydrocarbons from copiers, etc., in the recirculated air within a building. The following evaluation criteria with regard to CO_2 in offices has been suggested by a Canadian investigator [2]:

CO_2 Level (ppm)	Comments
less than 600	Adequate outside air
600-800	Occasional complaints, particularly if the air temperature rises.
800-1000	Complaints are more prevalent.
greater than 1000	inadequate outdoor air in HVAC system; complaints are general.

Relative Humidity

Relative humidity[3] has been shown to have a significant effect on the control of airborne infection. At 50 percent RH, the mortality rate of certain organisms is the highest and the influenza virus loses much of its virulence. The mortality rate of microorganisms decreases both above the below this value.

Low relative humidity is undesirable for reasons other than those based on human comfort. Low levels will increase evaporation from the membranes of the nose and throat and drying of the skin and hair. Some medical opinion attributes the increased incidence of respiratory complaints to the drying out of mucous membranes due to low indoor humidities in winter.[4]

Studies of indoor areas show that high temperatures (greater than 78°F) and low humidity (less than 30 percent) place employees in a "discomfort zone".[5]

MEDICAL 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. Of the 15 studies published to date which have examined the link between passive smoking and cancer, only three have not shown a statistically significant positive correlation between the two[6]. Active cigarette smoking remains the leading cause of lung cancer in the United States.

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.

6. Hydrocarbon vapors

Hydrocarbon vapors are released from dispersants and toners used in photocopying machines and telecopiers, from printing processes, and from certain cleaning compounds. Hydrocarbons can be irritants and, at high concentrations, are central nervous system depressants.

VI. RESULTS AND DISCUSSION

A. Environmental

Although the atmospheric air samples showed the levels of carbon monoxide (15 ppm) and carbon dioxide to be below the permissible OSHA and ACGIH limits, the carbon dioxide levels in certain areas (Table II) indicate that the amount of outside air being introduced into the building, were in the range where occasional complaints may become generalized, particularly if the air temperature rises. Many of the individuals in these areas are cigarette smokers. ASHRAE recommends seven occupants per 1000 square feet for smoking areas. Due to a lack of space in the building, the occupancy is much higher than 7 persons per 1000 $ft.^2$ in many areas. ASHRAE also recommend that 20 cubic feet of outside air per occupant be supplied in areas where smoking is permitted.

Very low relative humidity (as low as 17) and high temperature (78.5°F), (Tables 1A and 1B) place the employees in a discomfort zone.

All other contaminants (dust and organic vapors) were within the acceptable OSHA, ACGIH, or NIOSH recommended exposure levels. As previously stated, a sample of pipe coating taken in the boiler room showed no asbestos to be present.

B. Medical

a. Questionnaires

Demographic and Descriptive Variables

The mean (average) age of the 105 employees who gave their ages was 42; the median age was 41. Eighty-four (81%) of the 104 employees who gave their races were white and not of Hispanic origin; 14 (14%) were black, five (5%) were Hispanic and one (1%) was Asian or a Pacific Islander. Fifty-nine (55%) of the 107 who gaves their sexes were male; forty-eight (45%) were female. Fifty-three (50%) of those who indicated their length of schooling had completed twelve years of high school; six (6%) had finished their first year of college; five (5%) had finished their second year of college; 2 (2%) had completed their third year of college; 31 (29%) completed all four years of college; nine (9%) had a master's degree.

Eighty-two (87%) of the 94 who answered the question stated that they used a photocopier daily; 12 (14%) of the 85 who answered the question stated that they used a typewriter daily; 78 (77%) of the 102 who answered the question stated that they used a video display terminal daily.

Eighty (75%) out of the 107 who answered the question reported that they wear eyeglasses; three (4%) of the 86 who answered the question stated that they wore hard contact lenses; ten (11%) of the 88 who answered the question stated that they wore soft contact lenses.

Work in enclosed areas (C3P16 and 17)

Ninety (85%) of the 106 who answered the question stated that they worked in an open office area; sixteen (15%) of the 104 who answered the question stated that they work in an enclosed area.

Smoking at DIS

Twenty-three (21%) of the 108 who answered the question stated that they smoked at work; eighty-seven (81%) stated that people usually smoked in their area of work.

Other medical complaints

Thirteen (13%) of the 98 who answered the question had bronchitis or emphysema diagnosed by a physician. Five (5%) of the 95 who answered the question had heart disease diagnosed by a physician.

Air Movement, temperature, humidity, lighting, and odors in work areas

Five (5%) of the 108 said there was "frequently" too much air movement in their work area; 21 (20%) said there was occasionally too much; 82 (76%) said that too much air movement was rare. Eighty (74%) said that there was frequently too little air movement in their work areas; fifteen (14%) said that there was occasionally too little; 13 (12%) said that there was rarely too little.

Fifty-six percent (52%) said that the temperature in the work areas was frequently too hot; 37 (34%) stated that it was occasionally too hot; 15 (14%) stated that it was rarely too hot. Nineteen (18%) stated that the temperature was frequently too cold in their work areas; 54 (50%) stated that it was occasionally too cold, and 35 (32%) stated that it was rarely too cold.

Forty (37%) of the 107 who answered the question stated that there was frequently too much humidity in their work areas; thirty-one (29%) stated that it was occasionally too humid; 36 (34%) stated that excess humidity was rare.

Twenty-seven (26%) of the 106 who answered the question stated that there was frequently too little humidity in their work areas; 27 (26% stated that there was occasionally too little humidity; 52 (49%) stated that too little humidity was rarely a problem.

Eighty-six (80%) of the 108 stated that the air frequently felt stuffy in their work areas; 13 (12%) stated that it occasionally felt stuffy; 9 (8%) stated that stuffiness was rare. Thirty-two (30%) stated that there was frequently an unpleasant odor in their work areas; 45 (42%) said that there was occasionally an unpleasant odor; 31 (29%) said that an unpleasant odor was rare.

Forty-four (41%) stated that there was frequently too much noise in their work areas; forty (37%) stated that there was occasionally too much noise, 24 (22%) stated that too much noise was rare. Seven (7%) stated that the lighting was frequently too bright in their work area; eleven (10%) stated that it was occasionally too bright; 90 (83%) stated that excess brightness was rare.

Thirty-three (31%) said that the lighting was frequently too dark in their areas; 20 (19%) stated that it was occasionally too dark; 55 (51%) stated that excess darkness was rare.

Symptoms occuring at work

Sixty-six (67%) of the 99 who answered the question stated that they repeatedly had headaches while at work. Of these, 59 answered the question on frequency; of those, 31 (53%) stated they had headaches twice a week or more; 28 (48%) stated they had them once a week or less. Fifty (89%) of the 56 who answered the question felt their headaches were work-related. Seven (13%) of the 53 who answered the question had been sent home sick with headache; 11 (21%) of the 52 who answered this question had seen a doctor for their headaches.

Forty-three (44%) of the 97 who answered the question stated that they repeatedly had a dry, sore throat while at work. Of these, 40 answered the question on frequency; of those, 17 (43%) stated they had dry, sore throats twice a week or more; 23 (57%) stated they had them once a week or less. Nineteen (59%) of the 32 who answered the question felt their dry, sore throats were work-related. Four (13%) of the 30 who answered the question had been sent home sick with dry, sore throats; 12 (35%) of the 30 who answered this question had seen a doctor for their dry, sore throats.

Fifty-eight (61%) of the 95 who answered the question stated that they repeatedly had nasal or sinus congestion while at work. Of these, 52 answered the question on frequency; of those, 32 (62%) stated they had nasal or sinus congestion twice a week or more; 20 (39%) stated they had it once a week or less. Thirty (67%) of the 45 who answered the question felt that their congestion was work-related. Eight (18%) of the 22 who answered the question had been sent home sick with congestion; 24 (50%) of the 48 who answered this question had seen a doctor for their congestion.

Thirty-one (33%) of the 94 who answered the question stated that they repeatedly had a cough while at work. Of these, 28 answered the question on frequency; of those, 12 (43%) stated they had coughing at work twice a week or more; 16 (57%) stated they had it once a week or less. Fourteen (67%) of the 21 who answered the question felt that their coughing was work-related. Four (18%) of the 22 who answered the question had been sent home sick with coughing; 14 (42%) of the 24 who answered this question had seen a doctor for their coughing.

Twelve (13%) of the 93 who answered the question stated that they repeatedly had a cough while at work. Of these, 10 answered the question on frequency; of those, 4 (40%) stated they had wheezing at work twice a week or more; 6 (60%) stated they had it once a week or less. Ten (91%) of the 11 who answered the question felt that their wheezing was work-related. Four (33%) of the 12 who answered the question had been sent home sick with wheezing; 7 (70%) of the ten who answered this question had seen a doctor for their wheezing.

Nineteen (20%) of the 96 who answered the question stated that they repeatedly had shortness of breath while at work. Of these, 16 answered the question on frequency; of those, 5 (31%) stated they had shortness of breath twice a week or more; 11 (69%) stated they had it once a week or less. Eleven (92%) of the 12 who answered the question felt that their shortness of breath was work-related. Three (23%) of the 13 who answered the question had been sent home sick with shortness of breath; 7 (54%) of the 13 who answered the question had seen a doctor for their shortness of breath.

Sixteen (17%) of the 95 who answered the question stated that they repeatedly had chest tightness while at work. Of these, 10 answered the question on frequency; of those, 1 (10%) stated he had chest tightness twice a week or more; 9 (90%) stated they had it once a week or less. Thirteen (87%) of the 15 who answered the question felt that their chest tightness was work-related. Four (29%) of the 14 who answered the question had been sent home sick with chest tightness; 8 (57%) of the 14 who answered the question had seen a doctor for their chest tightness.

Fifty-eight (58%) of the 100 who answered the question stated that they repeatedly had eye irritation while at work. Of these, 49 answered the question on frequency; of those, 28 (57%) stated they had eye irritation twice a week or more; 21 (43%) stated they had it once a week or less. Forty-four (88%) of the 50 who answered the question felt that their eye irritation was work-related. Two (5%) of the 42 who answered the question had been sent home sick with eye irritation; 10 (22%) of the 45 who answered the question had seen a doctor for their eye irritation.

Symptoms occuring more frequently since individuals began work at DIS

The following numbers of workers stated that they had experienced the following symptoms more frequently since starting work at DIS: fatigue, 51 (48%) of 107 who answered the question; flu, 33 (32%) of 102; muscle pain, 21 (21%) of 102; chills and fever, 17 (17%) of 103; bronchitis, 17 (17%) of 103; abdominal pain, 14 (14%) of 102; numbness and tingling, 10 (10%) of 102; skin rash, 10 (10%) of 103; loss of appetite, 8 (7.8%) of 102; skin rash, 10 (10%) of 103; weight loss, 5 (5%) of 103.

Discussion of Questionnaire Data

The most common complaints occurring at work at DIS were respiratory and mucous membrane irritant complaints, along with headache. Low humidities, high temperatures, lack of sufficient space and sufficient make-up air, and CO from the smoking that occurs in most areas may all be associated with these complaints.

Some of the common constitutional symptoms, such as fatigue are also associated with ventilation and space problems. However, like headache, fatigue and muscle aches may also be related to VDT work, especially if breaks are too infrequent or if screens and work stations are not properly designed. Because 77% of Building 3 employees work with VDTs daily, it is important that this work be properly regulated (See Recommendations, Section VI).

Solvents, which are used by only a small percentage of workers, are also associated with headache, fatigue, and respiratory and mucous membrane irritant symptoms. Some are also associated with cancers, although those in use at DIS currently are not know to be so. Good ventilation is very important in areas where solvents are used. Adequate skin protection is also important, since solvents can be absorbed through the skin into the system.

b. Cancer

The union and employees together listed twenty-five current or former employees known to them to have had cancer. Of the total of

49 reported to have had cancer in the past 15 years, six (12%) are reported by employees who knew them to have had skin cancer; of these, two are known to have had their cancers removed and are still alive; the status of the other four is not known. One other person (4%) reportedly had "cancer of the skin and internal organs" and died. We could not obtain death certificates for any of these people.

Eight (16%) of the 49 reported cancer cases are said to have had cancer of the throat, but there may be some confusion in reporting here: two of these are reported simply to have had "throat cancer"; four are reported to have had cancer of the "throat -- lump on neck"; two are reported to have had "cancer of the throat -- esophagus." Those with a report of "lump on neck" may have been equally likely to have had skin cancer or leukemia as esophageal cancer; as we have no death certificate for any of these people, it is impossible to say what their actual diagnostic categories should be. Two of those with "lump(s) on neck" are reportedly still alive; two have died. One of those reported simply as having "throat cancer" has died; the status of the other is not known. Both of those with cancer of the esophagus have reportedly died. A death certificate of a ninth person reported to have had "cancer of the throat -- esophagus" showed that this person actually had cancer of the lung.

Four (8%) of the 49 reported cancer cases are said to have had lung cancer or have death certificates proving lung cancer; three of these are reported to have died and one had a lung removed and is still alive. One of the diagnoses and deaths was confirmed by death certificate.

One person reportedly had stomach cancer and died. Another reportedly had "stomach and liver cancer" and died. Another had bowel and liver cancer and died; this person's diagnosis and death were confirmed by death certificate. Another (2%) had liver cancer and died; this person's diagnosis and death were confirmed by death certificate.

Two (4%) reportedly had spleen cancer; one is said to have died and the other is said still to be alive. One (2%) reportedly had cancer of the lip and mouth and is still living. One (2%) reportedly had brain cancer and died. One (4%) had breast cancer and died. One (2%) reportedly had leukemia and died.

Seventeen (35%) have reportedly died but their type of cancer was not reported, one (2%) reportedly had cancer and is said to be alive; three (6%) have neither type of cancer nor mortality status reported.

Of the forty-nine workers on which we have information, twenty (41%) are reported to have worked in or near the tape library or computer room, the area of particular concern. However, we do not know how many workers have worked in the computer room over the last ten years, so we cannot say what percentage of computer room workers these twenty represent. According to employees, seven (35%) of the twenty had or have cancer of the throat, but one of these was incorrectly reported, according to the death certificate. Even if the rest are accurately reported, the four "lump(s) on neck" may not have been the same kind of cancer as the two remaining esophageal cancers.

Three (15%) have reported digestive cancers (liver, stomach, or bowel, or some combination); one of these is confirmed by death certificate. Two (10%) have lung cancers, either according to the employee listing (5%) or death certificate (5%). One (5%) reportedly had leukemia. One (5%) reportedly has cancer of the lip or mouth. Three (15%) reportedly had cancer but their diagnoses have not been reported.

Discussion of Cancer Data

Unfortunately, these data are not complete enough to allow us to draw any conclusions. The list was only a partial list to begin with, and only 3 (6%) of the death certificates were obtained for people on this partial list. Because most are not confirmed by death certificate, we cannot consider the diagnoses for most of the people on the list to be certain, but even supposing them to be correct, we still cannot draw any conclusions from them.

One reason for this is, when a cancer list is incomplete and the numbers are small, a "cancer cluster" can only be pinpointed when a group of people who share one work area or one exposure have the same or related types of cancer, and when this cancer is a rare one. For example, if mesothelioma, a very rare cancer, had been reported in many of the workers, a significant cluster would exist, because such a rare cancer is unlikely to be found in many people in one place. However, people on the worker-reported DIS list have a variety of unrelated cancers, and most of those cancers are among the most common in the U.S. One in four people in this country will eventually contract cancer; of these people, a large percentage will have skin cancer. Of those who die, most will have lung, breast, or digestive cancers.

VII. RECOMMENDATIONS

1. Introduce sufficient outdoor air (at least 20 cfm per occupant).

2. Increase the relative humidity to between 30 and 60%. Some of this increase may be accomplished by the introduction of outdoor air especially on days when the humidity is higher than that indoors. However, indoor humidity should not be increased above 60%.

3. The ventilation should also be monitored to insure a sufficient percentage of make-up air. These reports should be made available to the DIS Safety Office and to the union health and safety representatives.

4. When solvents are used to clean tapes or for other cleaning, good ventilation should be maintained.

5. Gloves should be worn when solvents are used. These gloves should be clean and relatively impermeable to that particular solvent. The manufacturer of a solvent can generally provide information on which gloves are appropriate. Rubber gloves are often permeable to solvents and should not usually be used. Gloves should be changed well before the solvent begins to come through them. Fresh gloves should be readily available at the work stations.

6. The union or the DIS safety office may wish to maintain a simple sheet of the "problem list" variety on all willing employees, in order to facilitate future studies and to alert safety personnel to possible problem areas. Such a sheet should include birthdate, social security number, a complete job history including jobs held before work at DIS, data of hire at DIS, departments at DIS and relevant dates, exposures to known hazards or chemicals (if any), medical problems and relevant dates of diagnosis, name of physician(s) or health care provider(s), name and address of next of kin or another knowledgeable informant. Some unions also ask their members to carry a small pocket booklet in which they record relevant symptoms, their dates, and possible associated exposures. These booklets are collected and new ones issued to members on a regular basis. Any information collected, whether in problem sheet or booklet form, should continue to be kept at DIS or at the union office after retirement or termination of employment, with the employee's consent.

VIII. REFERENCES

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3. American Society of Heating, Refrigerating and Air-Conditioning Engineers: Standard 62-1981: Ventilation for Acceptable Indoor Air Quality. Atlanta, GA (1981).

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5. Rahhans, G.S.: Indoor Air Quality and CO_2 Levels. Occupational Health in Ontario. 4:160-167 (1983).

6. Statement of C. Everett Koop, M.D., Surgeon General, Public Health Service, U.S. Department of Health and Human Services, before the Subcommittee on Civil Service, Post Office, and General Services Committee on Governmental Affairs, U.S. Senate, October 1, 1985.

7. Video Display Terminals. Bell Telephone Laboratories, Inc., 1983.

8. The Case of the Workplace Killers: A Manual for Cancer Detectives on the Job. November 1980, International Union, UAW.

Table IA

Defense Industrial Supply Center
Philadelphia, Pennsylvania

HETA 84-534

December 7, 1984

Percent Relative Humidity and Temperature
Building 3

Location	Time	Dry Bulb	Wet Bulb	%RH
ZC	08:30	72	52	21
	12:45	72	52	21
Computer B	09:00	69	55	39
	12:55	71	56	37
Computer A	09:05	69	55	39
	13:00	66	53	40
Computer C	09:10	74	57	33
	13:05	73	57	35
Computer D	09:20	71	52	23
	13:15	72	53	24
Center of B Section	10:10	73	51	17
	13:20	73	52	19
Safety Area	10:30	73	52	20
	13:40	73	52	20
Outdoors South Side	09:30	34	28	43
	13:30	40	32	37

Table IB

Defense Industrial Supply Center
Philadelphia, Pennsylvania

HETA 84-534

January 21-22, 1985

Percent Relative Humidity and Temperature
Building 3

January 21, 1985

Location	Time	Dry Bulb	Wet Bulb	%RH
ODAA	13:08	76	53	18
ODBE	13:12	74	56	30
OEBC	13:17	74	53	22
LS	13:30	75	53	20
EA/1	13:33	75	52	18
ZDA	13:38	73	52	21
ZB3	13:45	68	49	22
ZB3	15:35	67	48	18
ZBA	15:43	72	53	26
LS	15:50	76	56	26
EA/1	16:00	75	54	23
SGB-1	16:08	74	57	33
ODAA	16:15	76	56	26

January 22, 1985

OBAD	10:02	76	54	21
OCAD	10:10	75	53	20
OEAB	10:15	75	54	23
OEAD	10:20	77	55	22
ODBE	10:30	75	53	20
SGA/2	10:40	75	53	20
SFB	10:45	78	55.5	21
ECB	10:50	78.5	55	19
ESA/1	10:55	72	52	23
ZC	11:00	70.5	51	22
ZC	11:05	72	52	23
ODAA	14:32	78	58	27
ODEA	14:40	78	57	24
OBD	14:45	78	57	24
ODBD	14:50	76	55	22
ODBB	14:55	76	55	22
ZCAB	15:15	71	53	27

Table II

Defense Industrial Supply Center
Philadelphia, Pennsylvania

HETA 84-534

Carbon Dioxide Concentrations*

January 21, 1985

Area	Time	Concentration
ZDA	12:52-15:38	1050
EA/1	12:55-15:57	825
LS	12:57-15:48	1170
ODAA	13:04-16:12	1331

January 22, 1985

ADB (Rm B)	08:35-13:25	1000
ZCAB-3A	08:49-13:05	350
ZCB-3A	08:52-13:35	880
ZB-3	08:55-13:40	525
OBD-3D	09:23-13:14	760

*Denotes parts per million parts of air sampled.

Table III

Defense Industrial Supply Center
Philadelphia, Pennsylvania

HETA 84-534

January 22, 1985

Airborne Dust Concentrations*

Area	Time	Concentration
ODAA-3D	07:55-14:35	0.14
OEAD-3D	08:00-13:38	0.35
ODBB-3C	08:03-14:53	0.08
ZCAB-3A	08:12-15:13	0.33

*Denotes - Milligram per cubic meter of air sampled.

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