HEALTH HAZARD EVALUATION REPORT

HETA 92-139-XXXX
OHIO UNIVERSITY
JENNINGS HOME
ATHENS, OHIO

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 and authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

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

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I. SUMMARY

On March 2 and 3, 1992, the National Institute for Occupational Safety ar Health (NIOSH) conducted a health hazard evaluation at the Jennings Hou University, Athens, Ohio. This health hazard evaluation was conducted i a request by the Environmental Safety Coordinator, Department of Enviro Health and Safety, Ohio University, to investigate potential indoor environ quality problems (specifically, possible microbiological contamination) su because of one employee's (index case) health complaints. The complain specified in the request, included facial itching; eye and membrane irritati nausea and diarrhea at the office.

The investigation included a physical inspection of the heating, ventilatin conditioning (HVAC) systems for the first and second floor; the collection environmental air samples for analysis of cyclohexylamine and bioaerosol (specifically, saprophytic fungi, bacteria, and thermophilic actinomycetes) measurement of carbon dioxide, temperature, and relative humidity (RH).

The physical inspection did not reveal any visible evidence that would inc a significant or unusual microbial contamination source. Filters were free accumulation, ventilation ducts and exterior insulation were in good shap heating/cooling coils were free of standing water and/or slime accumulati Bioaerosol samples for fungi, bacteria, and thermophilic actinomycetes, c Andersen two-stage viable cascade impactors, did not support the conclu microbial sources of contamination. Bacterial concentrations ranged fron colony-forming units per cubic meter (CFU/m^3) both outdoor locations. F concentrations ranged from 63 to 706 CFU/m^3 in the conference room an respectively. The samples collected in the conference and complaint roor thermophilic bacteria were 4 and 14 CFU/m^3. Air samples had no detecta cyclohexylamine based on an analytical limit of detection of 0.01 mg/sam µg/liter for a 96 liter sampling volume. Mean carbon dioxide concentratio to 525 parts per million (ppm) for the sample collected at the reception d temperature measurements in the Jennings Home averaged 71°F; the RH measurements averaged 35%.

Questionnaires inquiring about the comfort and symptoms experienced v building were distributed to all available employees in the Jennings Hous questionnaires were returned to the NIOSH investigators. One individual, the index case, reported symptoms of runny nose and headaches. Specif quality complaints included lack of air circulation (stuffy feeling), noticeab and disturbing noises from the heat register. Evaluation of the medical re index case employee indicated that the bulk of these records were from p hospital and outpatient visits for reasons unrelated to working in this bui

This investigation did not find any current environmental exposures or conditions that would constitute a health hazard.

KEYWORDS: SIC 9441 (Administration of Social, Manpower, and Incom Maintenance Programs), indoor environmental quality, bioaerosols, fungi, thermophilic actinomycetes, cyclohexylamine

II. INTRODUCTION

On March 2 and 3, 1992, the National Institute for Occupational Safety ar (NIOSH) conducted a health hazard evaluation (HHE) at the Jennings Hom University, Athens, Ohio. This HHE was conducted in response to a requ February 5, 1992, from the Environmental Safety Coordinator, Environme and Safety, Ohio University, to investigate potential indoor environmental problems (specifically, possible microbiological contamination) suspected an employee's health complaints. This report presents the results of the environmental and medical assessment which includes a ventilation syste inspection, air sampling for cyclohexylamine (CHA) and bioaerosols, and measurement of temperature, humidity, and carbon dioxide (CO_2).

III. BACKGROUND

The administration offices of the College of Fine Arts, Ohio University, cur occupies the Jennings House. The building was originally constructed ir current usable capacity of approximately 2900 square feet. The occupan people, however, increased and frequent traffic can be observed at peak t the year (i.e., class registration). The heating, ventilating, and air-conditic system is maintained by the University. Smoking is not permitted in the spaces of the building.

According to the request, a single employee had "facial itching, eye and n irritation, nausea and diarrhea when at work." Prior to the NIOSH investig Environmental Safety Coordinator conducted an evaluation of the building and microbial contaminants. Environmental samples were collected for d of carbon monoxide, CO_2, oxygen, hydrogen sulfide, and formaldehyde le evaluation of airborne microbial contamination (settling plates). Tempera relative humidity (RH) were also measured. According to the Environmen Coordinator, the environmental sample results were unremarkable with tl of the settling plate samples. One of three settling plate samples was des having "numerous colonies," the other samples had "small numbers." It w point that NIOSH investigators were asked to further evaluate the building emphasis on microbial contamination.

IV. MATERIALS AND METHODS

A. *INDUSTRIAL HYGIENE EVALUATION*

Environmental samples were collected at selected locations throughou building for CHA and bioaerosols (specifically, saprophytic fungi, bacte thermophilic actinomycetes). In addition, direct measurement, at the s selected locations, was conducted for CO_2, temperature, and humidity Environmental sample locations are listed in Table 1 (refer to Figures 1 building floor plan and sample placement). All samples were collectec work shift of March 3, 1992.

To determine the concentrations of airborne microorganisms at selected locations in the building, the Andersen 2-stage viable cascade impactor was used at a flow rate of 28.3 liters per minute (lpm). The 50% effective cutoff diameter for the Andersen sampler is 8 µm - hence, larger, non-respirable particles are collected on the top stage and smaller, respirable particles are collected on the bottom stage. Standard Plate Count and Malt Extract agars were used for the enumeration of bacteria (thermophilics included) and fungi, respectively. The sample plates for bacteria were incubated at 30°C. The sample plates for thermophilic bacteria were incubated at 55°C to promote the growth of thermotolerant bacteria (specifically, thermophilic actinomycetes - TA). The sample plates for fungi were incubated at 28°C. A sample time of 10 minutes was used at all sample locations. location, three samples were collected for bacteria and fungi. For ther bacteria, single sample runs were made at two locations. Temperatur were recorded for each sample run.

Table 1. Environmental Sample Locations

SAMPLE LOCATION	SAMPLE TYPE		
	Bioaerosols	CHA	Temperature, Humidity, and CO_2
Next to HVAC unit (basement)		√	√
Reception desk (Room 109)			√
Complaint office (Room 106)	√	√	√
Kitchen (Room 103)			√
Non-complaint office (Room 110A)		√	
Non-complaint office (Room 203)		√	√
Conference room (Room 209)	√	√	√
Outdoors	√		√
Complaint office (temporary space)			√

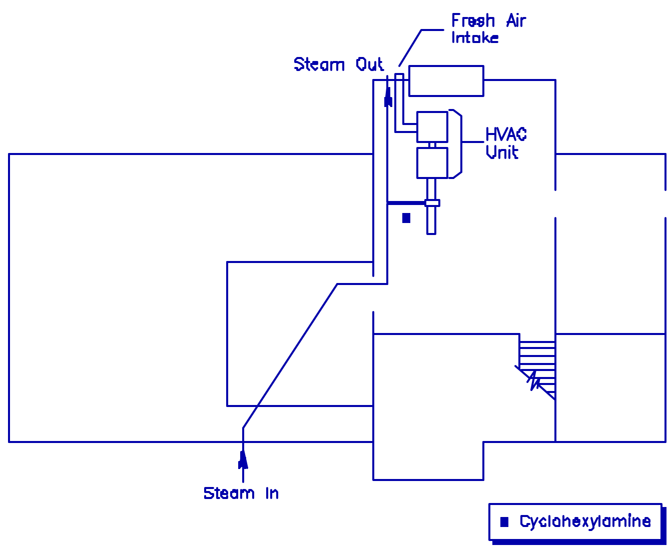

Figure 1. Basement Floor Plan with Sample Locations Indicated

Figure 2. First Floor Plan with Sample Locations Indicated

Direct measurements for temperature, humidity, and CO_2 were collected at each sample location for four rounds of beginning at 7:20 a.m., followed by subsequent sampling rounds at 8:56 a a.m., and 2:25 a.m. Carbon dioxide was measured using a Gastech RI 411 dioxide monitor (Gastech, Inc., Newark, California) calibrated before the day's collected using 800 parts per million (ppm) CO_2 in nitrogen (Alphagaz, Divisio Corporation, Cambridge, Maryland) as a calibrant. Temperature and RH were using a Vaisala HM 34 temperature and humidity meter (Vaisala Oy, Helsinki,

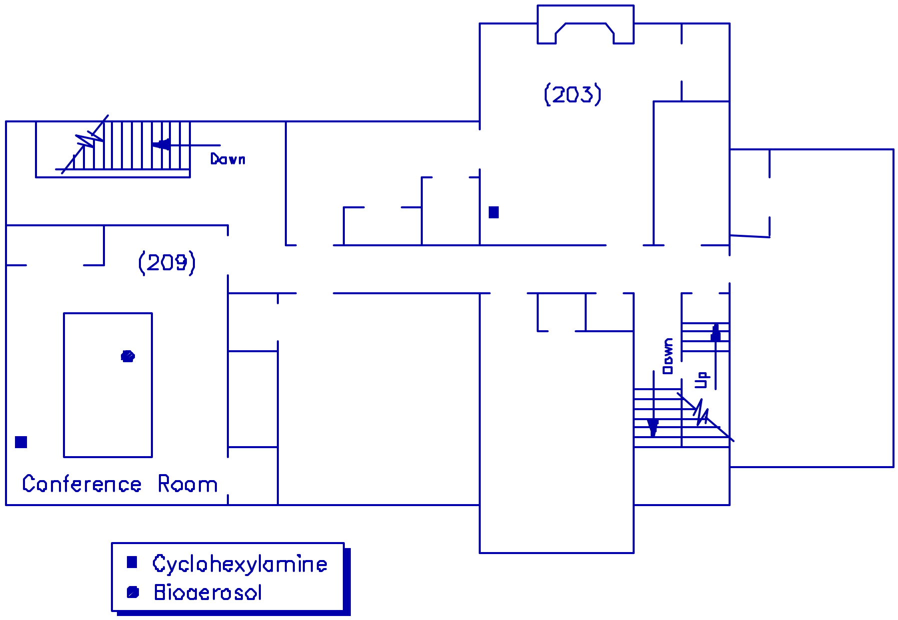

Figure 3. Second Floor Plan with Sample Locations Indicated

Steam is supplied to the building through a closed, common Universit
piped steam system. CHA is added to the central boilers to retard corı
system. Six full-shift environmental samples for CHA were collected o
sorbent tubes with Gillian personal sampling pumps calibrated at a sa
rate of 0.2 lpm prior to the field investigation. Samples for cyclohexyla
collected to investigate the possibility of leaks in the steam heat syster
sample tubes were analyzed using NIOSH Method 2010 with modifica
The silica gel tubes were desorbed (sonication) for 3 hours in 1.0 millil
0.1M H_2SO_4, 10% methanol, and water. From the solution, 0.5 ml wer
and basified with 0.5 ml of 0.3M KOH. The samples were analyzed w
Hewlett-Packard Model 5730A gas chromatograph equipped with a ni
phosphorus detector; the column was a 30 meter (m) x 0.32 millimete
fused silica capillary coated internally with 0.25 micrometer (µm) of Sta

B. *MEDICAL EVALUATION*

A medical evaluation was not initially involved in the investigation. Ho
questionnaires inquiring about symptoms experienced while in the bu
disseminated to all available employees (six were returned to the NIOS
investigators) and a medical officer was assigned, after the site visit, to
medical records of the employee mentioned in the request.

V. EVALUATION CRITERIA

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

The symptoms and health complaints reported to NIOSH by building occu
been diverse and usually not suggestive of any particular medical diagnos
associated with a causative agent. A typical spectrum of symptoms has
headaches, unusual fatigue, varying degrees of itching or burning eyes, i
the skin, nasal congestion, dry or irritated throats and other respiratory ir
Typically, the workplace environment has been implicated because worke
that their symptoms lessen or resolve when they leave the building. A n
published studies have reported high prevalences of symptoms among o
office buildings.[2-6] Scientists investigating indoor environmental problem
that there are multiple factors contributing to building-related occupant c
Among these factors are imprecisely defined characteristics of heating, ve
and air-conditioning (HVAC) systems, cumulative effects of exposure to lo
concentrations of multiple chemical pollutants, odors, elevated concentra
particulate matter, microbiological contamination, and physical factors su
thermal comfort, lighting, and noise.[9-14] Indoor environmental pollutants
from either outdoor sources or indoor sources.

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

Less often, an illness may be found to be specifically related to somethin
building environment. Some examples of potentially building-related illne
allergic rhinitis, allergic asthma, hypersensitivity pneumonitis, Legionnair
Pontiac fever, carbon monoxide poisoning, and reaction to boiler corrosio
The first three conditions can be caused by various microorganisms or ot
material. Legionnaires' disease and Pontiac fever are caused by *Legionell*
Sources of carbon monoxide include vehicle exhaust and inadequately-ve
kerosene heaters or other fuel-burning appliances. Exposure to boiler add
occur if boiler steam is used for humidification or is released by accident.

Problems NIOSH investigators have found in the non-industrial indoor en
have included poor air quality due to ventilation system deficiencies, over
volatile organic chemicals from furnishings, machines, structural compon
building and contents, tobacco smoke, microbiological contamination, an
pollutants; comfort problems due to improper temperature and RH condi
lighting, and unacceptable noise levels; adverse ergonomic conditions; a
related psychosocial stressors. In most cases, however, these problems
directly linked to the reported health effects.

Standards specifically for the non-industrial indoor environment do not e
the Occupational Safety and Health Administration (OSHA) and the Ameri
Conference of Governmental Industrial Hygienists (ACGIH) have publishe
standards or recommended limits for occupational exposures.[21-23] With f
exceptions, pollutant concentrations observed in non-industrial indoor en
fall well below these published occupational standards or recommended
limits. The American Society of Heating, Refrigerating, and Air-Condition
Engineers (ASHRAE) has published recommended building ventilation de
and thermal comfort guidelines.[24,25] The ACGIH has also developed a ma
guidelines for approaching investigations of building-related complaints
caused by airborne living organisms or their effluents.[26]

Measurement of indoor environmental contaminants has rarely proved to
determining the cause of symptoms and complaints except where there a
unusual sources, or a proven relationship between contaminants and spe
building-related illnesses. The low-level concentrations of particles and v
mixtures of organic materials usually found are difficult to interpret and u
impossible to causally link to observed and reported health symptoms. H
measuring ventilation and comfort indicators such as CO_2, temperature a
proven useful in the early stages of an investigation in providing informat
the proper functioning and control of HVAC systems.

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

The basis for measurements made during this evaluation are listed below

A. CARBON DIOXIDE

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

Indoor CO_2 concentrations are normally higher than the generally cons ambient CO_2 concentration (range 300-350 ppm). When indoor CO_2 concentrations exceed 1000 ppm in areas where the only known sourc breath, inadequate ventilation is suspected. Elevated CO_2 concentratio that other indoor contaminants may also be increased.

B. TEMPERATURE AND RELATIVE HUMIDITY

The perception of comfort is related to one's metabolic heat productior transfer of heat to the environment, physiological adjustments, and bo temperatures. Heat transfer from the body to the environment is influe factors such as temperature, humidity, air movement, personal activitie clothing. ANSI/ASHRAE Standard 55-1981 specifies conditions in whi more of the occupants would be expected to find the environment the comfortable.[25]

C. CYCLOHEXYLAMINE

Cyclohexylamine is a colorless to slightly yellow liquid with a strong, fi has been used in the production of rubber-processing chemicals, insec plasticizers, and dry-cleaning soaps; additionally, it has used as a corro inhibitor in boiler feed water. Cyclohexylamine is a severe irritant of th eyes and has a moderate sensitizing potential. The ACGIH Threshold L (TLV), the NIOSH Recommended Exposure Limit (REL), and the OSHA

Recommended Exposure Limit (PEL) are 10 ppm (≈ 40 mg/m^3) over an work shift.[21, 23, 27]

VI. RESULTS

A. *ENVIRONMENTAL*

The HVAC system consisted of two separate units; the first floor was s a unit in the basement and the second floor was serviced by a unit in t These units are similar in design to home HVAC systems with a variati heating component; heat is provided by coils connected to the Univers supply. The HVAC units are designed to provide a constant volume of the thermostatically controlled "on" cycle. The original design of the H specified 100% air recirculation in the interior spaces. However, in res health complaints, the basement HVAC unit was ducted to the outside fresh air (percentage unknown) to the offices (including the complaint serviced by this unit. Each HVAC unit was designed with coarse filters upstream end of the fan.

Smoke tubes were used to document the airflow patterns through-out building. General air movement in the offices resulted in airflow into tl This was expected due to the placement of the return air duct at the e hallway. Stagnant pockets of air were observed through-out the build HVAC unit was cycled "off."

Physical inspections were conducted on both HVAC units. The inspec reveal any visible evidence that would indicate a microbial contaminati Specifically, the filters appeared free of debree accumulation; the ventil and exterior insulation were in good shape; and the heating coils, and beneath, were absent of standing water and/or "slime" accumulation. I environmental samples for bioaerosols were collected at the request of Environmental Safety Manager.

The results of the CO_2 monitoring performed on March 3, 1992, are gr presented in Figure 4 . The mean CO_2 concentrations ranged from 37 million (ppm) for the outside sample to 525 ppm for the sample collec reception desk. All of the mean CO_2 concentrations were below the A recommended limit of 1000 ppm.[24] However, the occupancy rate in tl was less than the limiting criteria of 7 occupants per 1000 square feet in ASHRAE 62-1989. Observation of the individual data points (Apper not indicate a large variation in the concentrations over the course of tl It should be noted that the complaint room was vacant at the time of t therefore, the CO_2 value may not be representative. However, it is dou the occupancy of the office by a single individual would greatly influen concentration from those observed during the survey. This is validate small CO_2 variations among the other offices sampled.

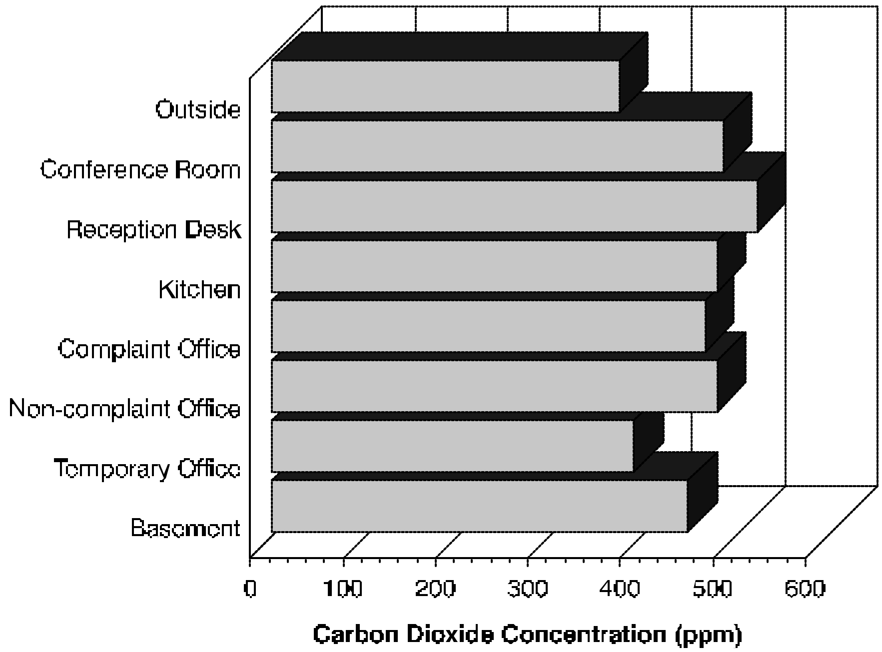

Figure 4. Mean Carbon Dioxide Concentrations at Various Locations

The concentration of CO_2 in offices designed for single occupancy can by intermittent occupant load--commonly observed in university enviro due to student traffic. For example, the mean CO_2 concentration in the area was higher than all other sample locations (refer to Figure 4). In a variance was greater than all other locations (the standard deviation w compared to less than 46 ppm for all other sample locations) suggesti fluctuation in the CO_2 concentrations over the work day. The increase concentrations and variance can be mainly attributed to the increased student traffic observed (at the time of the survey) in the reception area to other interior building locations. Increasing the fresh air supply in areas expected to receive greater student traffic can help to s variation and ensure that levels remain below recommended limits.

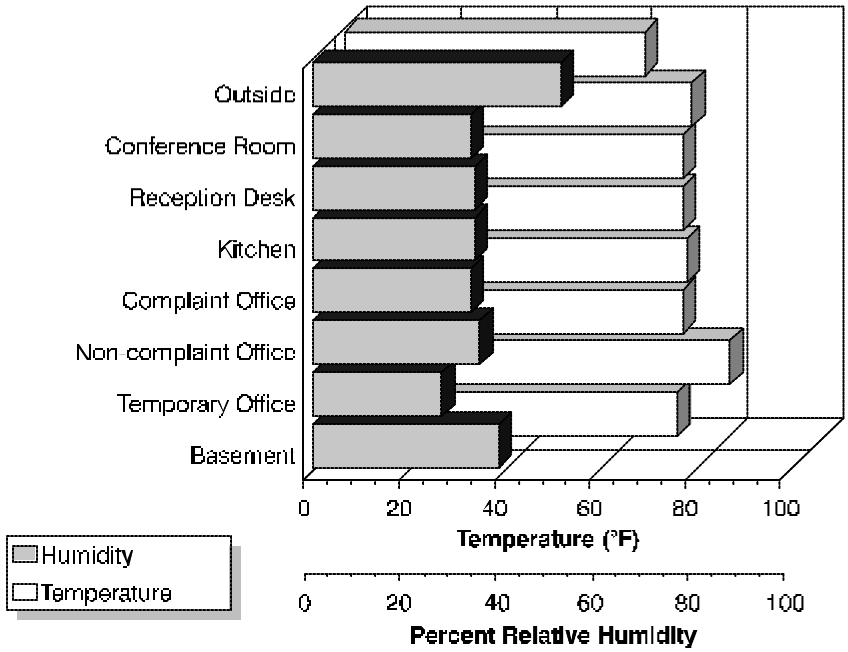

Figure 5. Mean Temperature and Humidity Concentrations at Various Locations

The results of monitoring for temperature and humidity are graphically in Figure 5. The mean temperature measurements ranged from 63°F a sampling location outside of the building to 81°F in the temporary offic (located in a separate building). The mean temperatures in the Jennin were fairly stable from office to office over the work day (overall mean (standard deviation of 1°F). The mean humidity measurements ranged the sampling location outside of the building to 27% in the temporary Similar to the temperature measurements, the RHs in the Jennings Ho fairly stable from office to office over the work day (overall mean of 35% standard deviation of 2%). The indoor temperatures and RHs, with the of the temporary office, are within the limits recommended by ASHRAI thermal comfort chart (Figure 6). This chart specifies the acceptable (a will feel thermally comfortable) ranges of operative temperature and humidity for persons clothed in typical summer and winter clothing, performing mainly sedentary activity.[24] The temperature in the temporary office was beyond the comfort range established for the winter months.

The air samples for cyclohexylamine were all non-detectable based on an analytical limit of detection of 0.01 mg/sample, which equates to a minimum detectable concentration of 0.1 µg/liter, assuming a sampling volume of 96 liters.

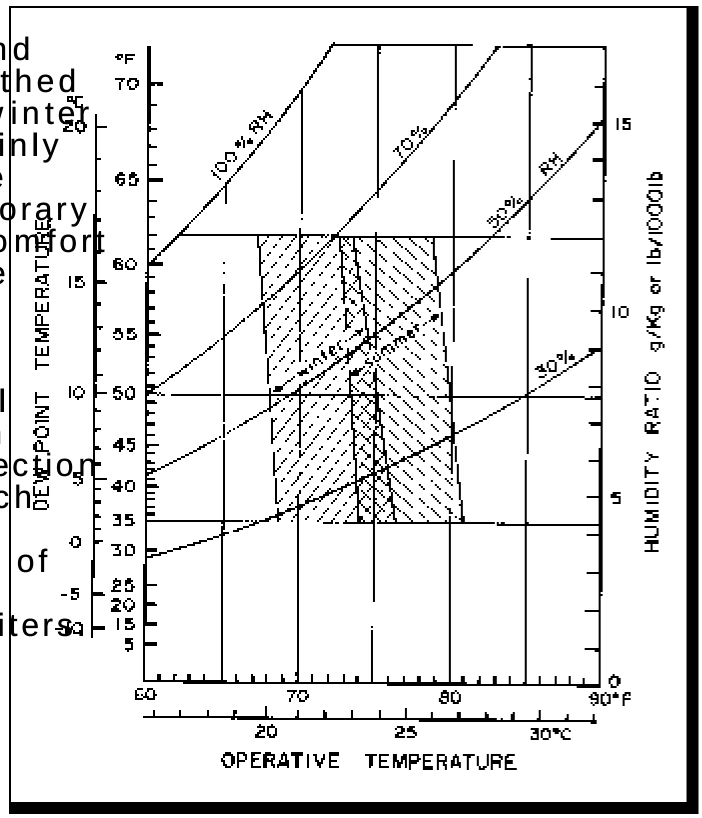

Figure 6. ASHRAE Thermal Comfort Chart

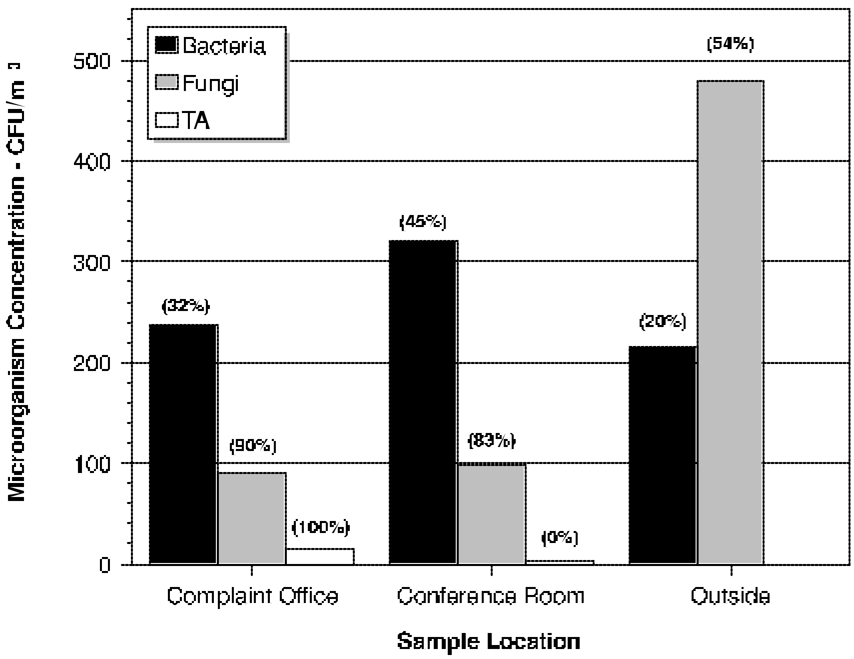

Figure 7. Microorganism Concentrations at Selected Building Locations (respirable fraction is noted above bars)

A graphical summary of the bioaerosol air sampling results (bacteria, f TA) is presented in Figure 7. Microorganism concentrations are indica bars and the respirable fraction is shown above the bars in parenthese samples in the complaint office had a mean bacteria content of 237 Co Forming Units per cubic meter of air (CFU/m^3) and a standard deviatio CFU/m^3; this is statistically similar (α level of 0.05) to the samples colle outdoors (mean of 320 CFU/m^3 and a standard deviation of 132 CFU/m the non-complaint office (mean of 216 CFU/m^3 and a standard deviatio 192 CFU/m^3). The percentage of respirable particles (defined by the sa the 50% effective cut-off diameter at 8 µm) were low for all sample loca respirable fraction in the complaint office (mean of 32% with a standar of 12%) and the non-complaint office (mean of 45% with a standard de 25%) were slightly greater than that encountered in the outdoor sampl 20% with a standard deviation of 1%). Observation of the taxa ranking the Appendix) indicates dissimilar species encountered indoors versus The bacterial component of the outdoor samples were composed of va *Bacillus* species; common gram-positive soil flora. However, indoors t bacteria were predominated by non-pathogenic, gram-positive species *Micrococcus*, *Cornyebacterium*, and *Staphylococcus*. These bacterial species are commonly associated with desquamated human and are a direct indication of occupant activity.[28] These bacterial speci identified in the complaint and non-complaint offices have not been dc as causative agents in hypersensitivity pneumonitis or other related bu illnesses.

The complaint office had a mean fungal content of 90 CFU/m^3 and a s deviation of 11 CFU/m^3, and the non-complaint office had a mean fung of 99 CFU/m^3 and a standard deviation of 52 CFU/m^3; these were stati below (α level at 0.05) the concentrations encountered outdoors (mear CFU/m^3 and a standard deviation of 286 CFU/m^3). In addition, the resu complaint office were statistically similar (α level at 0.05) to those of th complaint office. The percentage of respirable particles were high for t complaint office (mean of 90% with a standard deviation of 7%) and th complaint office (mean of 83% with a standard deviation of 11%) and g that encountered in the outdoor sample (mean of 50% with a standard 6%). Observation of the taxa ranking does not indicate **amplification** fungal species that have typically been associated with health effects (*Aspergillus*, *Penicillium*, *Sporobolomyces*, *Alternaria*, etc.).[26] In order to illicit immunologic responses in susceptible individuals, a mic must be present in the environment (reservoir), capable of propagation concentrations necessary to induce responses (amplification), and ava aerosol to the susceptible individual (dissemination).[12]

Cladosporium was the most predominant species in the outdoor samp is consistent with "normal" outdoor taxa ranking.[28] *Alternaria* was pro the top plate (non-respirable fraction) of some of the outdoor samples be a result of *Alternaria*'s larger spores in comparison to those of *Cladosporium*.[28] *Penicillium*, *Ulocladium*, and yeasts were also identified in small concentrations in the outdoor air. Indoors, the air w predominated by *Cladosporium* and *Penicillium*; lower concentrations other common saprophytic molds were also identified. *Penicillium* wa most numerous species on the bottom stage (respirable fraction) of ma indoor samples; however, the concentrations, when compared to thos encountered outdoors, were very similar supporting the conclusion of amplification. *Gliocladium* was identified as the predominant species of the samples in the complaint office which would indicate a possible reservoir. However, *Gliocladium* has not been associated with cases o hypersensitivity pneumonitis and the concentrations encountered wer low.

Results for thermophilic actinomycetes (TA) were only available as sing samples in the complaint office (14 CFU/m^3) and non-complaint office Although these numbers are not typical of levels which have been imp cases of hypersensitivity pneumonitis, their existence as an indicator o problem cannot be ruled out. The current knowledge concerning the l concentrations of TA's in the ambient environment is extremely limited inability to detect TA concentrations at "elevated levels" during the surv the result of an unfavorable operating state in the building ventilation s prefer warm temperatures and a humid environment) specific to the su period.

B. *MEDICAL*

Medical records of the employee mentioned in the request were suppl NIOSH investigator and reviewed by a NIOSH medical officer. The bulk records are from previous hospital and outpatient visits for reasons un working at this building. None of the medical tests described in these suggests an environmentally-induced disease. However, there are few any specific tests for such diseases. Carboxyhemoglobin was measur single test and was less than 1%, which suggests there was no expos carbon monoxide at the time of that test.

The six questionnaires did not reveal work-related health complaints fr individuals with one exception. One person reported symptoms of rur headaches. Specified air quality complaints included lack of air circula feeling), noticeable odors, and disturbing noises from the heat register

VII. CONCLUSIONS

The request was prompted by concerns of a single worker regarding the environmental quality and health symptoms including tearing eyes; itchir skin of the throat, neck, and cheeks; mucous drainage; occasional chest nausea; and diarrhea. The symptoms began in mid-January of 1991, wi occurrences entering the building and subsidence out of the building. Tl reports of interior water damage and pesticide use (over the past 4 years) smoking is not permitted in the building. A portable humidification unit operation for 4 years in the reception area but it's use has since been disc it was removed. Visual inspection of the unit indicated inadequate maint Evaluation of the medical records of the affected employee and environme sampling for CO_2, temperature, humidity, bioaerosols, and cyclohexylami support the conclusion of an environmental causative agent.

The building HVAC unit is designed to provide tempered air during the "o monitored by interior thermostats. This intermittent load may not be cap providing adequate fresh air (per ASHRAE guidelines) during peak occupa during class registration). Although CO_2 measurements at the time of th investigation did not indicate deficiencies in the ventilation system, durin seasonal periods when the ventilation system minimally operates and occ increases, additional monitoring for CO_2 should be conducted. If monitor concentrations surpass the ASHRAE criterion of 1000 ppm, efforts shoul increase the fresh air supply during times of increased occupancy.

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

Individual Results for Temperature, Humidity, and CO_2

LOCATION	TIME	TEMP (°F)	% HUMIDITY	CO_2 (ppm)
Basement	07:34 am	68	39	475
Basement	09:09 am	68	39	400
Basement	11:14 am	71	40	425
Basement	02:32 pm	71	39	500
Non-complaint Office	07:29 am	71	31	450
Non-complaint Office	09:04 am	70	34	500
Non-complaint Office	11:09 am	70	36	450
Non-complaint Office	02:35 pm	73	37	525
Complaint Office	07:22 am	69	35	475
Complaint Office	08:58 am	72	32	475
Complaint Office	11:05 am	72	32	450
Complaint Office	02:27 pm	74	34	475
Temporary Office	09:35 am	83	24	400
Temporary Office	11:23 am	80	28	425
Temporary Office	02:43 pm	80	30	350
Kitchen	07:26 am	71	32	525
Kitchen	09:02 am	70	33	450
Kitchen	11:07 am	70	35	450
Kitchen	02:30 pm	73	35	500
Outside	07:18 am	47	70	425
Outside	09:10 am	53	62	350
Outside	11:23 am	71	40	375
Outside	02:38 pm	81	35	350
Reception Desk	07:20 am	65	38	500
Reception Desk	08:56 am	72	32	500
Reception Desk	11:02 am	73	33	625
Reception Desk	02:25 pm	75	34	475
Conference Room	07:30 am	72	31	450
Conference Room	09:06 am	71	33	525
Conference Room	11:10 am	73	33	500
Conference Room	02:36 pm	76	33	475

Individual Results for Bioaerosols

SAMPLE NUMBER	SAMPLE TYPE	SAMPLE LOCATION	TIME OF DAY	COMBINED CONC (CFU/m³)	PERCENT RESPIRABLE	GENUS AND/OR SPECIES RANKING	
						TOP	BOTTOM
OU-1B	B	A	08:18	360	28%	Corynbacterium > Micrococcus + Yeasts	Bacillus sp. > Micrococcus sp. + Yeasts
OU-2B	B	A	08:35	152	23%	Staphylococcus sp. + Yeasts	Staphylococcus sp. + Yeasts
OU-3B	B	A	08:50	198	46%	Micrococcus luteus + Yeasts	Micrococcus luteus + Yeasts
OU-5B	B	B	09:26	427	71%	Micrococcus luteus	M. luteus > Staph. hominis
OU-6B	B	B	09:44	173	23%	Cornybacterium sp. + Yeasts	Cornybacterium sp. + Yeasts
OU-7B	B	B	10:01	361	40%	Micrococcus luteus	Micrococcus luteus
OU-9B	B	C	10:44	438	19%	Bacillus sp.	Bacillus sp.
OU-10	B	C	11:00	109	19%	Bacillus sp.	Bacillus sp.
OU-11	B	C	11:25	102	21%	Bacillus insolitus > Bacillus sp.	Bacillus insolitus > Bacillus sp.
OU-1F	F	A	08:18	85	84%	Cladisporium = Penicillium + Yeasts	Penicillium > Aspergillus > Cladisporium
OU-5F	F	A	08:35	85	84%	Cladisporium = Alternaria = Yeasts	Cladisporium > Penicillium > Aspergillus
OU-7F	F	A	08:50	85	95%	Gliocladium	Penicillium > Cladisporium > Aspergillum
OU-4F	F	A	09:08	106	96%	Gliocladium	Gliocladium > Penicillium > Cladisporium
OU-6F	F	B	09:26	176	84%	Yeasts > Alternaria	Penicillium > Cladisporium > Aspergillus >
OU-8F	F	B	09:44	78	91%	Cladisporium = Yeasts	Penicillium > Cladisporium > Aspergillus
OU-9F	F	B	10:01	63	67%	Cladiporium = Yeast = Penicillium = Epicoccum	Penicillium > Cladisporium
OU-10	F	B	10:20	78	91%	Cladisporium = Penicillium	Penicillium > Cladisporium
OU-11	F	C	10:44	706	50%	Alternaria > Cladisporium >> Penicillium	Cladiporium >> Alternaria > Penicillium
OU-12	F	C	11:00	346	56%	Cladiporium > Penicillium > Yeasts > Alternaria >	Cladiporium >> Alternaria >> Penicillium
OU-13	F	C	11:25	141	62%	Cladiporium >> Penicillium > Ulocladium	Cladiporium >> Penicillium
OU-14	F	C	11:38	728	48%	Alternaria > Cladisporium	Cladisporium
OU-4B	T B	A	09:08 am	14	100%		Streptomyces sp.
OU-8B	T B	B	10:20 am	4	0%	Streptomyces sp.	

Sample Type:
B = Bacteria
F = Fungi
T B = Thermophilic Bacteria

Sample Location:
A = Complaint Office
B = Conference Room
C = Outside