NIOSH HEALTH HAZARD EVALUATION REPORT

HETA 2006-0246-3023
West Virginia Department of Health and Human Resources, Bureau of Children and Families
Fairmont, West Virginia

September 2006

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DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

PREFACE

The Respiratory Disease Hazard Evaluations and Technical Assistance Program (RDHETAP) of the National Institute for Occupational Safety and Health (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 (OSH) Act of 1970, 29 U.S.C. 669(a)(6), or Section 501(a)(11) of the Federal Mine Safety and Health Act of 1977, 30 U.S.C. 951(a)(11), which authorizes the Secretary of Health and Human Services, following a written request from any employers 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.

RDHETAP also provides, upon request, technical and consultative assistance 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 NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Randy J. Boylstein, MS, REHS, of the RDHETAP, Division of Respiratory Disease Studies (DRDS). Field assistance was provided by Chris Piacitelli, MS, CIH. Desktop publishing was performed by Amber Harton.

Copies of this report have been sent to employee and management representatives at the West Virginia Department of Health and Human Resources and the OSHA Regional Office. This report is not copyrighted and may be freely reproduced. The report may be viewed and printed from the following internet address: http://www.cdc.gov/niosh/hhe. Copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161.

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.

Highlights of the NIOSH Health Hazard Evaluation of West Virginia Department of Health and Human Resources

Bureau of Children and Families
Fairmont, West Virginia

NIOSH received a confidential health hazard evaluation request to conduct an indoor air quality evaluation of the West Virginia Department of Administration building at 107-109 Adams Street, Fairmont, West Virginia.

What NIOSH Did

- Conducted a visual inspection of the building accompanied by maintenance supervisor
- Monitored the workplace for indoor air parameters (temperature, relative humidity, carbon dioxide, and carbon monoxide)
- Provided feedback to maintenance supervisor concerning conditions and activities within the building that could potentially have adverse impacts on indoor air quality

What NIOSH Found

- Water infiltration throughout the basement
- No ventilation in the basement
- Sidewalks sloping toward building promoting water infiltration on annex side of building
- The need for a complete testing and balancing of the HVAC systems
- Holes in the roof membrane

What Managers Can Do

- Reslope all sidewalks adjoining building to prevent water incursion
- Repair all water infiltration of the basement
- Provide a ventilation system for the basement that is separate from the rest of the building
- Have a complete testing and balancing of all HVAC systems conducted by a licensed company
- Replace or repair the roof membrane
- Replace/remove damaged synthetic stucco (Dryvit)
- Do not allow the use of the basement for office space until all repairs can be completed

What Employees Can Do

- Report indoor air quality concerns and health symptoms to management
- Promptly report water leaks or other factors that might impact air quality
- Comply with policies that are designed to protect air quality

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report # 2006-0246-3023

Health Hazard Evaluation Report 2006-0246-3023
West Virginia Department of Health and Human Resources, Bureau of Children and Families
Fairmont, West Virginia

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SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a health hazard evaluation (HHE) at the West Virginia Department of Health and Human Resources, Bureau of Children and Families, 107-109 Adams Street, Fairmont, West Virginia. The environmental concerns included mold, poor indoor air quality (IAQ), and mold contamination in the heating, ventilating and air-conditioning (HVAC) system. The listed health concerns included sneezing, coughing, headaches, respiratory infections, and pneumonia.

The NIOSH response consisted of a basement to roof visual inspection of the building including the heating, ventilating and air-conditioning (HVAC) systems by two industrial hygienists accompanied by the building maintenance supervisor. Real-time monitoring of temperature, relative humidity, and concentrations of carbon dioxide and carbon monoxide were also conducted.

The inspection found the basement to suffer from multiple areas of water incursions. Rooms and elevator shafts were found to contain water soaked debris. The sidewalks adjacent to the building were found to slope toward the annex side of the building and exacerbated the water incursion problems. The HVAC systems were not balanced properly and the fresh air intakes could not be properly controlled. Holes were found in the roof membrane and the exterior synthetic stucco was damaged.

These environmental findings constitute a public health risk from dampness and are plausibly related to building-related health complaints. We recommend building remediation to prevent water incursion in order to improve employee health and to prevent additional illness.

NIOSH conducted a site visit to the West Virginia Department of Administration building at 107-109 Adams Street, Fairmont, West Virginia to address employee concerns about contamination of the indoor air and the health effects they were experiencing. The basement was found to have water infiltrations, soaked debris and high relative humidity levels. The HVAC systems for the building were found to be imbalanced and in need of a complete testing and re-balancing. The roof membrane was found to have holes, and the synthetic stucco exterior was damaged. We recommend remediation to prevent water incursion in order to prevent employee illness.

Keywords: NAICS Code 923130 (Individual and Family Social Services); indoor air quality, IAQ, dampness

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INTRODUCTION

This report is in response to a confidential request received by the National Institute for Occupational Safety and Health (NIOSH) to conduct a health hazard evaluation (HHE) at the West Virginia Department of Health and Human Resources, Bureau of Children and Families, 107-109 Adams Street, Fairmont, West Virginia. The environmental concerns included mold, poor indoor air quality (IAQ), and mold contamination of the heating, ventilating and air-conditioning (HVAC) system. The listed health concerns included sneezing, coughing, headaches, respiratory infections, and pneumonia.

BACKGROUND

In 2004, NIOSH received a similar HHE request from workers at this facility. At that time, telephone interviews were conducted with workers and management. NIOSH concluded their investigation with recommendations to increase the HVAC filter changes to every three months, and to install dehumidifiers and fans in areas with high moisture content. NIOSH also recommended that all visible mold growth be remediated. A selection of documents were also provided to requesters and management including: *A Brief Guide to Mold in the Workplace, IAQ Tools for Schools, Mold Remediation in Schools and Commercial Buildings, and NYC Guidelines on Assessment and Remediation of Fungi in Indoor Environments.* During telephone conversations workers voiced concern that little had been done by management to remediate the problems after NIOSH had provided guidance in 2004. They still believe their respiratory symptoms are a result of the conditions in the building.

The building is approximately 120,000 square feet with five floors plus a basement and annex. It was built in the 1920s as a department store. The original interior had an open floor design with plaster walls and hardwood floors and an exterior façade of brick. The building's heating was provided by steam boilers and cooling by natural circulation from open windows. In 1986, the state of West Virginia acquired the building and converted it into office space. The exterior brick façade was covered with an Exterior Insulation and Finish System (EIFS), known as Dryvit or synthetic stucco. The interior was divided into offices. A three-story annex was added and three air handling units were placed on the roof, two on the main building and one on the annex. A central core of ductwork was placed below each air handler extending down to the first floor. Flexible ducting was then branched off to supply air to the offices. Space above ceiling tiles was used as a return air plenum.

METHODS

On July 11, 2006, the maintenance supervisor, currently the only on-site maintenance person for this building, agreed to conduct a visual inspection of the building and the HVAC units with two NIOSH industrial hygienist. During that site visit measurements were taken of carbon dioxide (CO_2), carbon monoxide (CO), temperature (°F) and relative humidity (RH) with a Q-TRAK™ Plus Indoor Air Quality Monitor, Model 8554 (TSI Incorporated, Shoreview, MN).

We started our inspection in the basement which was primarily used to house the hot water boilers that provide perimeter base board heating to the building, generators and other maintenance equipment. There was only one office space in the basement, which was being used by the on-site maintenance person. We also inspected the elevator shafts. We then inspected the exterior of the building and adjacent sidewalks. We continued our inspection of the 1st through 5th floors and the annex (which is accessible on each floor). We finished the inspection at the roof top HVAC units and examined the rubber roof membrane.

RESULTS

Immediately after entering the basement, we noticed a strong moldy odor. There was no ventilation system for the basement. The perimeter walls on the annex side were found to be very damp with numerous water leaks. We found a number of small rooms along the outer walls, mostly on the Meredith Street side that contained water-soaked wood debris on the floor and rusting metal beams. The maintenance supervisor mentioned to us that there is a project in the planning stages that would fill these rooms with gravel then seal them off from the rest of the building. We found several operating sump pumps in the basement but the floor and walls were still very damp. The elevator shafts were damp and contained debris. In one room there were several natural gas-fired boilers; upon inspection we detected the faint smell of natural gas. The maintenance supervisor said the system had recently been inspected, but he would ask the company that maintains this equipment to test them for leaks.

The outside areas to the right of the main entrance door and around the right corner of the building (on the parking lot side), were found to have sidewalks that sloped directly toward the building. Large cracks with damaged calking were noticed at the junction of the walls and sidewalk and the maintenance supervisor mentioned that during rains, water runs into these cracks and directly into the basement. We also noticed several large bulged and stained areas of the synthetic stucco half way up the building on the Cleveland Avenue side. This damage appeared to be caused by water intrusion, possibly from the roof or the seams of the synthetic stucco.

The 1st floor customer service area was listed as an area of concern in the HHE request and the maintenance supervisor mentioned that he had received numerous complaints from workers in this area. The customer service area was a rectangular room with approximately 10 cubicles. We found 2 supply air vents on one side of the room but none on the other. At the time of the inspection, the door to the hallway was open, and a large fan was positioned to bring air in from the hallway. The maintenance supervisor mentioned to us that since he had received numerous complaints from this area, he had placed a return air vent on the opposite side of the room from the 2 supply vents in an effort to create more airflow. Employees subsequently complained that this was ineffective, so he removed the vent.

Throughout the rest of the building we saw numerous areas where employees had placed paper or tape over supply vents in an effort to stop cold air blowing directly on them. We also saw ceiling tiles with small water stains. On the 2nd floor, the maintenance supervisor showed us an area where employees had complained that it was too hot. He said that upon inspection there appeared to be no air flowing through the supply vents. After he traced the flexible ductwork back from these vents to a main branch, he found that the ductwork system for this area was clogged with dust. After removing the clog, air flow resumed to this area, but this change then caused a different area to become too hot for the employees, requiring additional adjustments to the system.

The interiors of the 2 main building HVAC units, including the coils, filters, ducting and fiber insulation, appeared to be relatively clean. We had been informed by requesters that in 2004, fiber insulation was removed from much of the ductwork throughout the building due to the numerous complaints about poor IAQ. During our inspection, the only fiber insulation visible was within the HVAC units. The drain pans, which remove condensation from the coils, were flowing normally. We noticed some dry, mold-like growth on some of the rubber insulation wrap that covers pipes within the HVAC units. The maintenance supervisor showed us the new fresh air inlet controls that had recently been installed. He mentioned that the controls were not operating properly, and he was unsure of how much fresh air was actually entering the building. He said he would ask the installer to revisit the building as soon as possible and instruct him on how to adjust the controls to the proper flow rate. The roof of the building was flat and covered with a rubber

membrane and a layer of gravel. We found several large tears in the membrane at the seam with the walls of the elevator shaft equipment room. The maintenance supervisor mentioned that roof replacement was another project that was in the planning stages.

Table 1 includes the indoor air quality measurements taken throughout the building.

DISCUSSION AND CONCLUSIONS

Since the basement has no HVAC system, the relative humidity was very high (80.2%). Relative humidity at this level promotes the growth of microorganisms such as molds. Although the basement air is not connected to the main HVAC system which supplies air to the building, air from the basement can reach the main areas through the fire escape stairs and particularly the elevator shafts. When an elevator is raised it will act to pull air from the basement upwards into the building. The indoor temperatures ranged from 72 to 78.4°F on floors 1 through 5. This variation is possibly due to the fact that there appears to be inadequate control of the HVAC system. The CO_2 levels were below the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)-recommended 1,050 ppm level for an occupied space. CO levels were also within normal limits.

Temperature and relative humidity (RH) measurements are often collected as part of an IAQ investigation because these parameters affect the perception of comfort in an indoor environment. The perception of thermal comfort is related to one's metabolic heat production, the transfer of heat to the environment, physiological adjustments, and body temperature. Heat transfer from the body to the environment is influenced by factors such as temperature, humidity, air movement, personal activities, and clothing. The *ANSI/ASHRAE Standard 55-2004: Thermal Environmental Conditions for Human Occupancy*, specifies conditions in which 80% or more of the occupants are expected to find the environment thermally acceptable. Assuming slow air movement and 50% RH, the operative temperatures recommended by ASHRAE range from 68.5°F to 76°F in the winter, and from 75.5°F to 80.5°F in the summer (see table below). The difference between the two is largely due to seasonal clothing selection. ASHRAE also recommends that RH be maintained at or below 65%. The U.S. Environmental Protection Agency recommends maintaining indoor relative humidity between 30-50% because excessive humidity can promote the excessive growth of microorganisms.

Relative Humidity	***Winter Temperatures***[1]	***Summer Temperatures***[1]
30%[2]	69.5 to 77.0°F	75.5 to 81.5°F
40%	69.0 to 76.5°F	75.5 to 81.0°F
50%[3]	68.5 to 76.0°F	75.0 to 80.5°F

[1] Applies to occupants wearing typical summer and winter clothing, with a sedentary to light activity level.

[2] Humidity levels below 30% may cause irritated mucus membranes, dry eyes, and sinus discomfort.

[3] The U.S. Environmental Protection Agency recommends maintaining indoor relative humidity below 60% and ideally in a range from 30% to 50% to prevent mold growth.

Recently, the Institute of Medicine of the National Academies conducted an extensive review of past scientific studies on the health effects of damp buildings and concluded that excessive indoor dampness is a public health problem. Dampness in buildings can promote the growth of house dust mites, cockroaches, and mold and other microbial agents, and can contribute to the breakdown of building materials and furnishings. A variety of substances and particles derived from mold, bacteria, insects, and building materials may be released into the air as a result.

Based on its review of the research that has been conducted, the Institute of Medicine found *sufficient evidence* that indoor dampness or mold is associated with asthma symptoms (in sensitized asthmatic persons), cough, wheeze, and nasal and throat symptoms. In addition, the Institute of Medicine found *sufficient evidence* that exposure to mold or bacteria in damp indoor environments is associated with hypersensitivity pneumonitis, an allergic pneumonia. It found *limited or suggestive evidence* that exposure to indoor dampness is associated with the development of shortness of breath and asthma.

There are no established health-based standards for acceptable levels of biological agents in the air, and because limited short-term air sampling may be misleading, NIOSH indoor air experts do not currently recommend routine air sampling for mold in indoor air quality evaluations. Hidden mold and moisture-damaged building materials are sometimes associated with health effects in building occupants. As a general rule, after necessary repairs have been made to prevent further water entry into a building, mold and moisture-damaged materials should be cleaned or removed with appropriate containment to minimize exposure to building occupants. (Criteria for cleaning mold-damaged materials can be found in the enclosed document: *NYC Guidelines on Assessment and Remediation of Fungi in Indoor Environments.*)

There is no scientific basis for "clearance" air sampling for mold to demonstrate that a building is safe for occupants after water leaks are repaired, moldy and damaged materials removed, and musty odors are no longer evident. The best evidence that a building is safe after remediation may be that employees no longer experience building-related symptoms. In larger populations of workers, using employee health questionnaires may be helpful to collect information on building-related symptoms, particularly among persons new to the building after remediation (i.e., those without "sensitizing" historical exposures during a period of water damage). However, even if most employees experience improvement in their symptoms after remediation, and new employees remain free of building-related symptoms, some employees with allergic conditions may not notice an improvement. Because their immune systems may continue to react to very small amounts of substances to which they are allergic, such individuals may have to avoid the building even after otherwise successful remediation. An individualized management plan (such as assigning an affected employee to a different work location, perhaps at home or a remote site) is sometimes required, depending upon medical findings and recommendations of the individual's physician.

In summary, our most important environmental observation is that this building has ongoing water incursion and associated dampness. Damp indoor spaces are associated with many of the symptoms mentioned by requesters. This water incursion is a public health problem for building occupants and requires remediation to improve health and prevent building-related illness.

RECOMMENDATIONS

This building has a variety of issues which need to be addressed as soon as possible. The maintenance supervisor mentioned that there was a plan in place to seal off certain unused rooms that border the perimeter walls in the basement and install a new roof membrane. He also said that he would have the natural gas powered boilers in the basement inspected for natural gas leaks. The other issues that need immediate attention are:

- Reslope all sidewalks adjoining building to prevent water incursion.
- Repair all water infiltration of the basement.
- Remove all water soaked debris from the basement and elevator shafts.
- Provide a ventilation system for the basement, separate from the rest of the building. The basement should be under negative pressure relative to the rest of the building to prevent air from the basement being circulated through the entire building via elevator shafts and stairwells.
- A complete testing and balancing of the HVAC systems by a licensed company is essential for the facility to meet environmental standards. Adjusting a system to operate satisfactorily requires testing, adjusting, balancing and calibrating every control device to design criteria. It also needs well designed placement of supply and return vents to allow for evenly distributed air flow. A properly balanced system provides occupants with a comfortable environment in which to work and operates efficiently, reduces energy consumption and extends maintenance intervals and equipment life cycles.
- After roof repairs have been completed and all leaks have been stopped, have damaged synthetic stucco on the exterior of the building replaced by a licensed company that is familiar with this material. There have been a number of cases in synthetic stucco construction where the material was installed incorrectly, allowing water to leak behind the synthetic stucco and remain trapped, which created a moist environment and promoted the growth of mold (see attached document for information on problems associated with synthetic stucco and the following website by the EIFS industry members association for help in locating an inspector: http://www.eima.com/commercial_eifs.htm).
- Until all repairs can be made to the building, the maintenance supervisor should be relocated from his basement office to another floor.

We recommend that a proactive approach in identifying and correcting the source of water responsible for moldy odor and remediating any water-damage or mold contamination found. We also recommend the following information on building-related symptoms as a guide to evaluating the effectiveness of any building repairs. Early and frequent communication with building occupants is important both to prevent IAQ problems from occurring and to secure their cooperation when solving existing problems. Occupant complaints about IAQ should be taken seriously and investigated fully. It is important that clear procedures for recording and responding to IAQ complaints be established to ensure adequate and timely response and to prevent small complaints from becoming major health or comfort problems. These include:

- Logging all complaints or problem reports,
- Collecting information about each complaint,
- Ensuring confidentiality,
- Determining a plan for response,
- Identifying appropriate resources for response,
- Applying remedial action,
- Providing feedback to building occupants regarding the complaint and response actions, and
- Follow-up to ensure that remedial action has been effective.

NIOSH recommends that management encourage all occupants to seek guidance from their physicians if they feel they have a building-related medical condition.

TABLE

Table 1. Indoor air quality measurements taken throughout the building.

Floor/area	**CO_2**	**CO**	**°F**	**%RH**
Basement-central area	720	0.5	73.8	80.2
Basement-boiler room	817	0.3	75.0	80.2
1-customer service area	773	0.3	78.4	44.6
2-DHHR area	608	0.1	76.1	50.6
3- job service area	534	0	72.0	48.0
4-Verizon area	555	0.1	76.0	48.0
5-child advocate area	560	0	72.0	58.0
Outside (morning)	382	0.0	82.6	53.4
Outside (afternoon)	397	1	94.0	44.0

APPENDIX

Heating, Ventilating, and Air-Conditioning Actions:

Maintaining good indoor air quality requires attention to the building's HVAC system; the design and layout of the space; and pollutant source management. HVAC systems include all of the equipment used to heat, ventilate, and cool the building; to move the air around the building (ductwork); and to filter and clean the air. These systems can have a significant impact on how pollutants are distributed and removed. HVAC systems can even act as sources of pollutants in some cases, such as when ventilation air filters become contaminated with dirt and/or moisture and when microbial growth results from stagnant water in drip pans or from uncontrolled moisture inside of air ducts. Because of the HVAC system's importance, good indoor air quality management should include attention to the following information.

a) Ventilation System Design

The air delivery capacity of an HVAC system is based in part on the projected number of people and amount of equipment in a building. When areas in a building are used differently than their original purpose, the HVAC system may require modification to accommodate these changes. For example, if a storage area is converted into space occupied by people, the HVAC system may require alteration to deliver enough conditioned air to the space.

b) Outdoor Air Supply

Adequate supply of outdoor air, typically delivered through the HVAC system, is necessary in any office environment to dilute pollutants that are released by equipment, building materials, furnishings, products, and people. Carbon dioxide (CO_2), a normal constituent of exhaled breath, is an indicator of whether sufficient quantities of outdoor air are being introduced into an occupied space. ASHRAE recommends that the indoor CO_2 concentration be within 700 parts per million parts air by volume (ppm) of the outdoor concentration for comfort (odor) reasons. This would typically correspond to indoor concentrations below 1050 ppm since outdoor CO_2 concentrations usually range between 300 to 350 ppm. Elevated CO_2 concentrations suggest that other indoor air contaminants may also be increased and that the amount of outdoor air introduced into the ventilated space needs to be increased. Distribution of ventilation air to occupied spaces is essential for comfort.

c) Outdoor Air Quality

When present, outdoor air pollutants such as carbon monoxide, pollen, and dust may affect indoor conditions when outside air is taken into the building's ventilation system. Properly installed and maintained filters can trap many of the particles in this outdoor supply air. Controlling gaseous or chemical pollutants may require more specialized filtration equipment and sometimes relocation of the outdoor air intakes.

d) Equipment Maintenance

Diligent maintenance of HVAC equipment is essential for the adequate delivery and quality of building air. All well-run buildings have preventive maintenance programs that help ensure the proper functioning of HVAC systems.

ASHRAE guidelines provide specific details on ventilation for acceptable indoor air quality. A ventilation system expert can help meet ASHRAE ventilation guidelines in the building. ASHRAE's most recently published ventilation standard (*ANSI/ASHRAE 62.1-2004: Ventilation for Acceptable Indoor Air Quality*) recommends outdoor air supply rates that take into account people-related sources as well as building-related sources of contaminants. For office spaces, conference rooms, and reception areas, 5 cubic feet per minute of outside air per person (cfm/person) is recommended for people-related sources, and an additional 0.06 cfm for every square foot (cfm/ft^2) of occupied space is recommended to account for building-related sources.

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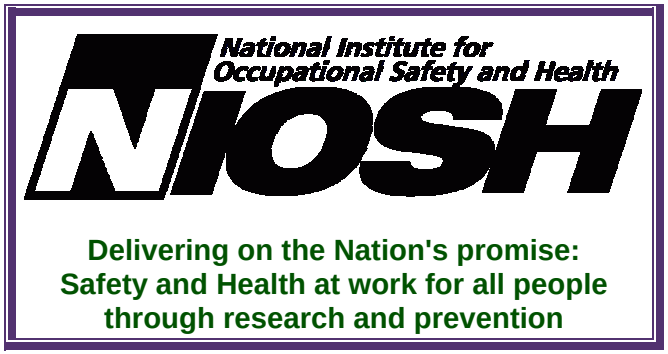

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