# HEALTH HAZARD EVALUATION REPORT

# HETA 92-0319-2459
# HOWARD UNIVERSITY
# WASHINGTON, D.C.

# 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) wich 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 relate trauman and disease.

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**HOWARD UNIVERSITY**
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## I. SUMMARY

On July 8, 1992, the National Institute for Occupational Safety and Health **(NIOSH)** received a confidential employee request to conduct a health hazard evaluation **(HHE)** at the Howard University School of Engineering **(SOE)**. Employees were concerned that a variety of physical agents, as well as airborne and waterborne contaminants, might be linked to a reported cluster of thyroid disorders among SOE personnel who worked at L.K. Downing Hall.

In August 1992, NIOSH investigators made an initial site visit and toured the SOE, obtained building plans, conducted employee interviews, reviewed the Occupational Safety and Health Administration **(OSHA)** 200 logs of illness and injury, made limited environmental measurements, and collected historical information regarding research activities in the SOE from official University records. Two additional site visits were conducted in the fall of 1992, during which environmental sampling for asbestos and ionizing radiation were conducted at L.K. Downing Hall. Closing conferences were held at the conclusion of each of the three site visits with representatives of the faculty and staff, and/or the University Office of Safety and Health, and recommendations were made to alleviate or remediate any problems identified.

Ionizing radiation measurements were performed at various locations in the SOE that contained radiation sources, such as Plutonium-Beryllium **(PuBe)** and depleted uranium. Sampling locations were chosen based on where workers were located in the past and on the day of measurements. Results indicated that radiation levels were below the Nuclear Regulatory Commission **(NRC)** occupational exposure limits.

Airborne asbestos was not detected in any of the areas sampled. However, laboratory analyses confirmed the presence of amosite asbestos in bulk material samples collected from steam-pipe lagging and debris found on the carpet in two offices where workers worked within five feet of badly damaged lagging. Indoor environmental quality **(IEQ)** measurements indicated that carbon dioxide **($CO_2$)** measurements in some areas were at the American Society of Heating,

Refrigerating and Air-conditioning Engineers **(ASHRAE)** recommended maximum of 1,000 parts per million **(ppm)**. Relative humidity measurements ranged from 41% to 45%, and all measurements were within the ASHRAE comfort zone of 30% to 60%. However, temperature readings ranged from 76.4°F to 82°F, and some exceeded the ASHRAE comfort zone for summertime of 73°F to 79°F.

> Based on a review of the information collected during this evaluation, we found no evidence to suggest that the reported thyroid-related health problems are attributable to the work environment at L.K. Downing Hall. The occurrence of asbestos in damaged steam-pipe lagging, constitutes a potential health hazard and indicates a need to improve the asbestos maintenance program at the SOE. Recommendations to reduce the

**Keywords:** SIC 8221 (Colleges, Universities, and Professional Schools), asbestos, ionizing radiation, thyroid.

# II. INTRODUCTION

On July 8, 1992, the National Institute for Occupational Safety and Health **(NIOSH)** received a confidential employee request to conduct a health hazard evaluation **(HHE)** at the Howard University School of Engineering **(SOE)**. The requestors noted that a variety of physical agents, as well as airborne and waterborne contaminants might be linked to a reported cluster of thyroid disorders among SOE personnel who worked at L.K. Downing Hall. NIOSH investigators conducted three site visits to respond to this request.

On August 31, 1992, NIOSH investigators made an initial site visit at the SOE, which is housed in L.K. Downing Hall. An opening conference was held and attended by the NIOSH investigators, the Dean of the SOE, an employee representative, and the university safety officer. Following the conference, NIOSH investigators toured the SOE, obtained building plans, conducted employee interviews, reviewed the OSHA 200 log of illness and injury, made limited environmental measurements, and collected information about the history of research activities in the SOE building. On September 21-22, 1992, and November 22-24, 1992, NIOSH investigators returned to the SOE to conduct environmental sampling for asbestos, and to perform ionizing radiation surveys, respectively. Closing conferences were held with appropriate university officials at the conclusion of each site visit to present recommendations for eliminating or minimizing potential occupational hazards.

# III. BACKGROUND

*A. Thyroid Disorders*

Employees in the SOE became aware about what appeared to be an unusually high incidence of health problems (especially thyroid disorders) among 43 full-time, support-staff employees in April 1992. These self-reported problems included one thyroid malignancy, one non-malignant thyroid tumor, four cases of thyroid enlargement, one lymphoma, one case of sarcoidosis, one case of an enlarged lymph node, and various other complaints. As a result of this concern, the SOE was inspected by a team from Howard University's insurance carrier. The insurance carrier (noting that there are over 85 employees in the department and that the problems cited above are relatively common in the general population) concluded that the problems were not associated with workplace exposure.

In June of 1992, concerned employees who disagreed with the insurance carrier's conclusions sent a memorandum to all SOE staff inquiring about health complaints. Based upon this survey and word-of-mouth information, 19 individuals (17 current and 2 former SOE employees) were identified who reported health complaints that they attributed to their work environment.

*B. Facility Description*

The Howard University SOE was founded in 1911, and has been a major source of minority engineering graduates, in particular, African-Americans, for over 83 years. The SOE awards bachelors degrees in chemical, civil, electrical, mechanical systems, and computer science engineering. The graduate program presently offers masters and doctoral degrees in computer science, electrical, civil, mechanical, chemical, and urban systems engineering. The SOE enrolls approximately 1,100 students per year, of which about 70% are undergraduate students. The SOE awarded its first masters and doctoral degrees in 1968 and 1976, respectively.

The SOE is housed in L.K. Downing Hall. This 96,000 square foot building was constructed on a graded lot in 1952. In 1974, a 24,000 square foot addition was constructed at the southern end of the existing building. The two buildings are separated by a driveway which runs between them, but they are connected by a walkway on the second and third floors of the facility. Steam heat for L.K. Downing Hall is provided from the university power plant. Steam pipes throughout the building are wrapped with either asbestos or fiberglass pipe lagging. The building does not have a central cooling system, but some areas and offices are cooled with window air-conditioning units or rooftop package units. The rooftop package units have been added since the original construction of the building. Since there is no central cooling system, most areas of the building do not have supply air ducting except office areas served by rooftop package units. Areas where cooling is not provided rely solely on natural ventilation during the cooling season.

C. Past Occupational Ionizing Radiation Exposures

Information about previous radiation sources used at the SOE was obtained from reviewing official Howard University records, including —

- Monitoring and inventory records maintained by the university Radiation Safety Office (RSO).
- Discussion with the university Safety Officer.
- Contents of appropriate doctoral dissertations and masters theses maintained by the main university library.
- Annual departmental reports which are compiled and maintained by department heads.
- Discussions with SOE officials about the program of study in nuclear engineering.

As part of the SOE's teaching and research program, the Department of Nuclear Engineering **(DNE)** operated a sub-critical reactor and a small accelerator. In addition, the DNE maintained a Nuclear Regulatory Commission **(NRC)** license for four one-curie plutonium-beryllium **(PuBe)** sources, and 2,500 kilograms **(Kg)** of depleted uranium. In 1989, the DNE program was eliminated, however, the radioactive sources were still being maintained, as of the last NIOSH site visit, in the old DNE area under lock and key in a radiation designated area. The SOE is actively trying to properly dispose of or transfer these sources from the building since they are no longer needed. All other ionizing radiation generation sources that were part of the DNE program have been removed from L.K. Downing Hall.

The review conducted by the NIOSH investigators on all SOE-approved doctoral dissertations and masters' theses approved by the SOE covered the last 20 years. The purpose of this search was to identify possible research topics that specifically used agents that could cause thyroid disorders. The NIOSH investigators found two theses that were of interest. Both theses described work involving the use of Technetium-99m **(Tc-99m)** radioisotope, in 1976 and 1977. Tc-99m is a short-lived radioisotope with a half-life of about 6 hours. It can be taken up at several places in the body, including the thyroid.

The NIOSH investigators also reviewed annual reports published by the University for various departments and found that around 1975, one of the SOE faculty members obtained a NRC grant of about $20,000 to work on Tc-99m.

Some of the past and present SOE faculty members utilized low-level radioisotopes for research programs, grants, and studies. The radiation materials used in these studies have been under the control of the NRC as well as the university Radiation Safety Office **(RSO)**. At the RSO, NIOSH investigators reviewed all existing records pertaining to activity in the SOE, including lists of authorized radioisotopes users, license renewals, over-exposure reports, film badge users, radioisotope swipe and leak testing records, waste disposal records, and past Atomic Energy Commission license approvals. Film badge records for SOE radiation users in most cases reflected less than 100 milliroentgen **(mR)** cumulative exposure, except for three situations of cumulative exposure as high as 500 mR. These levels are all well below the occupational exposure limits given in
10 CFR part 20.

As a result of this review, NIOSH investigators determined that at least four different radiation sources were used in the past at the SOE. These sources were the four one-curie PuBe sources, 2,500 kgs of depleted uranium material, low-level radioisopes used in approved research projects under the auspices of the RSO, and the Tc-99m radioactive material.

D. Other Environmental Assessments Performed at the SOE.

In 1978-79, a private consultant performed a complete survey of the existing engineering building to assess compliance with basic safety and health practices. Several recommendations resulted from the survey, and most were adopted by the

SOE. No mention of ionizing radiation or any medical problems were discussed in the consultant's report.

Before the NIOSH investigation, the university Safety and Health Office contracted a consulting firm to conduct an indoor air quality assessment at the SOE.

# IV. METHODS

The methods used by the NIOSH investigators in this evaluation were designed to answer the following two questions:

- Was there any source of occupational exposure in the SOE within the last 20 years that could have caused the reported thyroid disorders?

- Are there any present occupational health hazards at the SOE?

*A. Medical Interviews*

Medical interviews were conducted with 11 of the 19 employees identified in the employee survey conducted by SOE personnel as having health complaints which they believed were related to their work environment. All interviewed employees were asked to provide a history of their employment at the SOE and to locate, on a floor plan, offices that they had occupied during their tenure at L.K. Downing Hall. Employees having health problems who were not present during the initial NIOSH site visit were contacted via telephone or mail. Medical records of interviewed employees who had visited a physician were reviewed.

*B. Methods used to evaluate present occupational exposures at the SOE.*

To assess current potential occupational exposures, NIOSH investigators collected limited environmental measurements, toured various research and laboratory areas, made ionizing radiation measurements, and inspected L.K. Downing Hall for the presence of asbestos-containing materials.

### 1. Ionizing Radiation Measurements

Using old faculty rosters and with the help of current staff members, general work areas or rooms occupied by staff and faculty members with thyroid disorders were identified. On November 22 to 24, 1992, the RSO staff and NIOSH investigators jointly performed surveys in these areas using two Howard University radiation measurement systems to measure radiation levels. One system was a model-2 Ludlum exposure meter with a Ludlum model 44-6 Geiger-Mueller **(GM)** probe utilizing a variable window shield to discriminate between moderate to high levels of beta and gamma radiation. This system was designed to measure radiation in units of milliroentgen per hour. The second system was a model-3 Ludlum survey meter with a Ludlum model 44-3 scintillation probe designed to measure low levels of beta-gamma radiation in units of counts per minute. Measurements were obtained on different floors in the SOE where workers were expected to be present, such as rooms, hallways, closets, and near exposed water drain pipes, on floors, and underneath sinks. Selected measurements were also made outside and near ceiling locations. Both measurement systems had been calibrated within 6 months of the survey date using standard calibration procedures adopted by the Radiation Safety Office and approved by the NRC under the university's broad by-product license.

**2. Environmental Measurements**

a. Temperature, relative humidity, and carbon dioxide measurements.

During the first site visit, temperature, relative humidity **(RH)**, and $CO_2$ measurements were collected in those areas served by rooftop package units, as well as, areas where natural ventilation is used for cooling. $CO_2$ concentrations were measured using a Gastech direct reading Portable $CO_2$ Monitor (Model RI411), set in the 60–second average mode. Air temperature and RH were measured using a hand-held, direct-reading, electronic Vaisala HM34 Humidity and Temperature Meter.

b. Asbestos sampling

Based on visual observation, it was suspected that asbestos fibers may have been released from damaged steam-pipe lagging at various locations within the SOE and dispersed into the immediate work areas. To determine if asbestos was present in the air or on work surfaces, bulk material samples of steam-pipe lagging and surface samples were collected and analyzed for asbestos, and general area air samples for asbestos were collected on September 21 and 22, 1992.

General area air samples for asbestos were placed at stationary locations at a height approximating the breathing-zone. Asbestos samples were collected using an open-face 25 millimeter **(mm)** diameter filter cassettes, that contained a 0.45- to 1.2-µm cellulose ester membrane filters and had a conductive cowl. The filter cassettes were connected via tygon tubing to battery-powered sampling pumps calibrated to operate at an airflow rate of 3.0 liters per minute **(lpm)**. Sample volumes ranged from 729 to 939 liters. All of the air samples were quantitatively analyzed for fibers by phase contrast microscopy

**(PCM)** according to NIOSH Method 7400.[1] Based upon PCM fiber counts and filter loading, 11 of
13 samples submitted for asbestos analyses were selected for further analyses by transmission electron microscopy **(TEM)** according to NIOSH Method 7402.[1]

Bulk analysis for asbestos is used to determine its presence in suspected materials. Typically, bulk material samples for asbestos analysis consist of various insulating materials, settled dust, and other materials. In this investigation, bulk material samples of steam-pipe lagging, friable particles, and settled dust were collected. Polarized light microscopy **(PLM)** was used to analyze the bulk material samples according to NIOSH Method 9002.[1] The PLM technique is useful for the qualitative identification of asbestos and the semi-quantitative determination of asbestos content of bulk samples.

Environmental air monitoring is used to characterize current exposure potential, and settled-dust bulk samples are used for determining if airborne asbestos fibers have been released in the past and what percentage of the settled material is asbestos. The percent asbestos is determined and reported as a percent area observed in the microscope field. This percent is not converted into percent mass because of the uncertainties in densities and shapes of the particles and fibers. In addition, PLM can be used to identify the specific type of asbestos. The two most common types of asbestos in the U.S. are amosite and chrysotile. Settled dust samples were obtained using an air sampling pump, with a 25-mm filter in line, as a vacuum cleaner, for sweeping an area until the filter noticeably changed in color.

# V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ evaluation criteria for the assessment of a number of chemical (and physical) agents. The primary sources of environmental evaluation criteria for the workplace are the following:

**1)** NIOSH Criteria Documents and Recommended Exposure Limits **(RELs)**.[2]

**2)** The U.S. Department of Labor, Occupational Safety and Health Administration **(OSHA)** Permissible Exposure Limits **(PELs)**.[3]

**3)** The American Conference of Governmental Industrial Hygienists' **(ACGIH)** Threshold Limit Values® **(TLVs)**.[4] The objective of these criteria for chemical agents is to establish levels of inhalation exposure to which the vast majority of workers may be exposed without experiencing adverse health effects.

Full-shift and shorter duration inhalation criteria are available depending on the specific physiologic properties of the chemical substance. Full-shift limits are based on the time-weighted average **(TWA)** airborne concentration of a substance that most workers may be repeatedly exposed to during a normal 8- or 10-hour day, up to 40-hours per week for a working lifetime, without adverse effect. Some substances have recommended short-term exposure limits **(STELs)** or ceiling limits which are intended to supplement the full-shift criteria where there are recognized irritative or toxic effects from brief exposures to high airborne concentrations. STELs are based on TWA concentrations over 15-minute time periods, whereas, ceiling limits are concentrations which should not be exceeded even momentarily.

Occupational health criteria are established based on the available scientific information provided by industrial experience, animal or human experimentation, and epidemiological studies. Differences between the NIOSH RELs, OSHA PELs, and the ACGIH TLVs® may exist because of different scientific philosophy and interpretations of technical information. When comparing the exposure criteria, it should be noted that **employers are legally required to meet those levels (and any conditions) specified by an OSHA PEL**. The legal rulemaking process for promulgation of OSHA PELs is an arduous and time consuming task and the OSHA PELs may be required to take into account the technical and economical feasibility of controlling exposures in various industries where the agents are used. In contrast, the NIOSH RELs are primarily based upon the prevention of occupational disease without assessing the economic feasibility of the affected industries. ACGIH is not a governmental agency; it is a professional organization whose members are industrial hygienists or other professionals in related disciplines and are employed in the public or academic sector. TLVs® are developed by consensus agreement of the ACGIH TLV® committee and are published annually. The documentation supporting the TLVs® (and proposed changes) is periodically reviewed and updated if believed necessary by the committee. It is not intended by ACGIH for TLVs® to be applied as the threshold between safe and dangerous inhalation exposure.

It is important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these occupational health exposure criteria. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, previous exposures, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, or with medications or personal habits of the worker (such as smoking, etc.) to produce health effects even if the occupational exposures are controlled to the limit set by the evaluation criterion. These combined effects are often not considered by the chemical specific evaluation criteria. Furthermore, many substances are appreciably absorbed by direct contact with the skin, thus, potentially increase the overall exposure and biologic response beyond that expected from inhalation alone. Finally, evaluation criteria may change over time as new information on the toxic effects of an agent become available. Because of these reasons, it is prudent for an employer to maintain worker exposures well below established occupational health criteria.

A U.S. Court of Appeals decision vacated the OSHA 1989 Air Contaminants Standard [*AFL-CIO v OSHA*, 965F.2d 962 (11th cir., 1992)]; so OSHA is now enforcing the previous 1971 standards (listed as Transitional Limits in 29 CFR 1910.1000, Table Z-1-A).[5] However, some states which have OSHA-approved State Plans will continue to enforce the more protective 1989 limits. NIOSH encourages employers to use the 1989 limits or the RELs, whichever are lower.

The pertinent evaluation criteria and toxicological background information for the chemical substances and radiation evaluated are presented below:

### *A. Ionizing Radiation*

Ionizing radiation is produced naturally by the decay of radioactive elements or artificially by such devices as X-ray machines and high energy accelerators. A radioactive nucleus is one that spontaneously changes to a lower energy state, emitting particles and often gamma rays in the process. The particles commonly emitted are alpha particles and beta particles.

Alpha particles, which interact readily with matter to produce ions, usually have energies of from 4 to 8 million electron volts **(MeV)**. They travel a few centimeters in air and up to 60 microns into tissue. The high energy and short path result in a dense track of ionization along the path of the particles, which produces biologic damage in the tissues with which the particles interact. Alpha particles will not penetrate the stratum corneum of the skin and thus are not an external hazard; but if alpha-emitting elements are taken into the body by inhalation or ingestion, internal exposure may result.

Beta particles interact much less readily with matter than do alpha particles and will travel up to a few centimeters into tissue or many meters in air. Exposure to external sources of beta particles is potentially hazardous, but exposure internally is more hazardous.

Gamma rays are primarily an external hazard since they can travel further in air than either alpha or beta particles, and their biologic effects are better known than those of any of the other ionizing radiations.

The effect from external radiation sources depends on the penetrating ability of the particular radiation. Thus, alpha radiation is of no concern externally, and beta is stopped in the outer tissues — the depth depending on energy. Very low energy X or gamma radiation is attenuated quite rapidly.

Entry of radiation sources into the body during occupational exposures is principally from breathing air containing particulate or gaseous radionuclides, although ingestion and skin absorption can also occur.

The early experience of radiation workers (including various nuclear accidents, exposures of radium dial-painters, casualties from atomic bomb explosions) and data from research projects provide clear evidence that high levels of ionizing radiation definitely create somatic damage and may induce genetic damage. The occupational somatic effects include radiodermatitis, epilation, acute radiation syndrome, cancer, leukemia, cataracts, and sterility. The genetic effects resulting from occupational exposures are to a great extent still unknown. Moreover, it is important to remember that a mutation produced by radiation is similar to one caused by a mutagenic chemical or to one occurring spontaneously.

The applicable ionizing radiation occupational exposure standard is given in 10 CFR part 20 and, in general, limits exposures to an annual total effective dose equivalent of 5 rems or 50 millisieverts **(mSv)**.

### B. *Asbestos*

In testimony to OSHA, NIOSH has testified that there is no safe airborne concentration of fibers for any asbestos mineral.[6,7,8] NIOSH supported the OSHA proposal to reduce the PEL for asbestos to 0.1 fibers per cubic centimeter of air **(f/cc)** for all workers.

The current NIOSH REL for asbestos is 0.1 f/cc.[8] However, even at this concentration, OSHA has estimated that the mortality risk would be 3.4 deaths per 1,000 workers for a lifetime of exposure to asbestos.[9] Therefore, NIOSH has urged that the goal be to eliminate exposures to asbestos fibers or, where they cannot be eliminated, to limit them to the lowest feasible concentration.[6,8] NIOSH investigators therefore believe that any detectable concentration of asbestos in the workplace warrants further evaluation and, if necessary, the implementation of measures to reduce exposures. The OSHA PEL for asbestos limits exposure to 0.2 f/cc as an 8-hour TWA.[10] OSHA has also established an asbestos excursion limit for the construction industry that restricts worker exposures to 1.0 f/cc averaged over a 30-minute exposure period.[11]

*C. Indoor environmental quality (IEQ)*

Measuring ventilation and comfort indicators such as $CO_2$, temperature, and RH provides information relative to the proper functioning and control of heating, ventilating and air-conditioning **(HVAC)** systems. When conducting IEQ evaluations NIOSH investigators use the recommended building ventilation design criteria and thermal comfort guidelines published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers **(ASHRAE)**.[12,13]

Carbon dioxide is a normal constituent of exhaled breath and, if monitored, can be used as a screening technique to evaluate whether adequate quantities of outside air are being introduced into an occupied space. ASHRAE's most recently published ventilation standard, ASHRAE 62-1989, Ventilation for Acceptable Indoor Air Quality, recommends outdoor air supply rates of 20 cubic feet per minute per person **(cfm/person)** for office spaces, and *15 cfm/person for reception areas, classrooms, libraries, auditoriums, and corridors*.[13] Maintaining the recommended ASHRAE outdoor air supply rates when the outdoor air is of good quality, and there are no significant indoor emission sources, should provide for acceptable indoor air quality. Indoor $CO_2$ concentrations are normally higher than the generally constant ambient $CO_2$ concentration (range 300 to 350 parts per million [ppm]). Carbon dioxide concentration is used as an indicator of the adequacy of outside air supplied to occupied areas. When indoor $CO_2$ concentrations exceed 1,000 ppm in areas where the only known source is exhaled breath, inadequate ventilation is suspected. Elevated $CO_2$ concentrations suggest that other indoor contaminants may also be increased. It is important to note that $CO_2$ is not an effective indicator of ventilation adequacy if the ventilated area is not occupied at its usual level.

Temperature and RH measurements are often collected as part of an IEQ investigation because these parameters affect the perception of comfort in an indoor environment. The American National Standards Institute **(ANSI)**/ASHRAE Standard 55-1981, specifies conditions in which 80% or more of the occupants would be expected to find the environment thermally acceptable.[13] Assuming slow air movement and 50% RH, the operative temperatures recommended by ASHRAE range from 68 to 74°F in the winter, and from 73 to 79°F in the summer. The difference between the two is largely due to seasonal clothing selection. ASHRAE also recommends that RH be maintained between 30 and 60% RH.[12,13] Excessive humidities can support the growth of microorganisms, some of which may be pathogenic or allergenic.

# VI. RESULTS

*A. Previous occupational exposure concerns*

Based on the information presented in the BACKGROUND section of this report, the only possible causal exposure agent identified for the thyroid disorders was Tc-99m, a radioactive material used by SOE graduate students around 1976-78. NIOSH investigators were unable to determine, however, whether the material was ever actually at the SOE or the amount of material used. Furthermore, no information existed which could help determine what rooms it was used in, or who ordered the material. Even if this radioactive material was ever used at the SOE, its radioactive decay is so quick that detectable amounts of the isotope would no longer be present.

*B. Current occupational exposures*

1. Physical Agents

a. Ionizing Radiation

*I.* The background level of beta/gamma ionizing radiation measured outside the SOE building was 0.02 mR/hr with the Ludlum 44-6 Geiger-Mueller meter and 350 counts per minute **(cpm)** with the Ludlum model 44-3 scintillation probe. The maximum level of radioactivity measured anywhere in the SOE building was less than 0.2 mR/hr. This level occurred in room 1114, the location of the old Nuclear Engineering Department. Measurements were performed at a desk located along a wall which separated the office area and the restricted radiation area containing 4 curies of Plutonium-Beryllium **(PuBe)** and 2,500 Kg of depleted Uranium material. This level of activity was due to the presence of the radioactive material in the restricted radiation area. This level is below the occupational exposure standard. Since this evaluation, the SOE has removed the depleted Uranium.

*ii.* After reviewing various records, no evidence was found to confirm that an operating reactor was ever installed at the SOE, even though a reactor housing compartment was built in the basement. However, the SOE did own and operate a sub-critical reactor **(SCR)** for teaching purposes for a number of years. This SCR was removed from the SOE about 7 years ago.

*iii.* Leak testing is still being performed on the Pu-Be sources on a quarterly schedule and appear to be performed in an appropriate manner. These sources are shielded in a locked room which is well posted. Since no work is performed with these sources, there is no occupational exposure.

*iv.* Room G-10 contained a large canister which was labelled radioactive and had a locked top which could not be opened.
No one at the SOE knew anything about this canister or what it contained.

b. Other Physical Agents

*I.* No sources of microwave or radiofrequency fields were found in the Electrical Engineering Department.

*ii.* Several rooms and areas on the ground floor contained lasers, which did not have proper warning signs posted. Moreover, NIOSH investigators did not see any laser eye protectors. Most of the lasers were rated at Class IV, which require the use of eye protection.

*iii.* Persons entering the Robotic Laboratory are immediately within the working envelope of a robot and its arm and appropriate guarding was missing.

2. Asbestos

During the opening conference, management representatives acknowledged the presence of asbestos-containing materials **(ACM)** in the SOE building, that previous asbestos abatement activities had occurred, and that ACM was still present in the building.

If properly managed, the mere presence of asbestos does not constitute a hazard. However, during the initial survey badly damaged steam-pipe lagging was noted in several areas, which suggests that this is not the case. Therefore, NIOSH investigators returned to conduct sampling for asbestos.

The results of laboratory analyses of the bulk material samples of steam-pipe lagging and debris are presented in Table I.

**Table I**

Howard University
School of Engineering
L.K. Downing Hall

Bulk Material Samples Results
September 21, 1992

| Sample Location | Percent amosite asbestos |
|---|---|
| Room G-024 - Heating Equipment room. Sample collected from steam-pipe lagging. | 20 - 25 % |
| South Entrance to North Wing. Particles of pipe lagging collected on ground. | 30 - 35 % |
| Room 1026 - Civil Engineering Department Office. Pipe lagging particles collected from carpet. | 40 - 50 % |
| Room 1028 - Photocopy room. Pipe lagging particles collected from carpet. | 34 - 40% |
| Room 1026 - Civil Engineering Department Office. Sample collected from pile of debris on floor. | none detected |

These results confirmed the presence of amosite asbestos in bulk material samples collected from the steam-pipe lagging and debris.
The areas where damaged steam-pipe lagging was identified included the heating equipment room (G-024), the copier room (1028), and the Civil Engineering Office (1026). It should be noted and emphasized that a comprehensive survey of all ACM in the building was not conducted by NIOSH, therefore, damaged steam-pipe lagging and/or other ACM materials may be present in other rooms or areas of the building.

The poor condition of the steam-pipe lagging in the areas identified was pointed out during the closing conference on September 1, 1992, and again after the September 21 to 22, 1992, survey. Additionally, it was strongly emphasized that this situation be given immediate attention and corrective action taken.

Even though sampling did not detect airborne asbestos, the presence of asbestos in the bulk material samples and the condition steam-pipe lagging in the areas previously identified, particularly the two offices where employees worked within five feet of the pipes, warranted immediate corrective action. The need for immediate action was further supported by the finding that debris on the carpet contained 34-50% asbestos. Additionally, the heating equipment room (G-014) was equipped with a wall exhaust fan that vented directly outdoors, without filtration, to an adjacent sidewalk area.

3. Indoor Environmental Quality

The results of indoor $CO_2$ measurements ranged from 475 ppm to 1,000 ppm. NIOSH investigators use the ASHRAE recommendation of 1,000 ppm for indoor $CO_2$ concentrations. All $CO_2$ measurements were 1,000 ppm or less. It should be noted that most areas were occupied by 2 or less persons at the time measurements were taken and are likely to have a higher occupancy at other times. The outdoor $CO_2$ concentration was 375 ppm, which is considered within the normal range for outdoors. Relative humidity readings ranged from 41% to 45%, and all measurements were within the ASHRAE comfort zone of 30% to 60%. Temperature readings ranged from 76.4°F to 82°F, and some exceeded the ASHRAE comfort zone for summertime of 73°F to 79°F.

4. Other safety and health issues

a. Several laboratory doors with windows were covered with an opaque material preventing visual oversight of the laboratories.

b. Compressed gas cylinders in several laboratories were either not secured or improperly secured.

c. Several large 12-volt Ni-Cd batteries were found improperly stored on the shipping dock. The SOE officials on the walk-through tour indicated that the batteries had been there for several weeks for disposal. These batteries should be treated as hazardous materials and properly disposed of.

d. The smoking of tobacco products was observed in several areas inside the SOE.

### *C. Health Complaints*

The NIOSH investigators reviewed all available information gathered about health problems among department employees (58 full-time faculty and 47 support staff) listed in a 1991 to 1992 School of Engineering Phone Directory. Since the incidence of thyroid tumors and hyperthyroidism have been observed to increase among populations who share a history of external thyroid irradiation, NIOSH investigators focused on these problems. Two diagnosed thyroid tumors (one malignant) and one diagnosed case of hyperthyroidism were identified among the 105 full time faculty and support staff between 1980 and 1992. Both individuals with tumors were employed as support staff and were not officially involved with past radiation experiments. Moreover, one of these individuals was not employed by the SOE until March of 1978, when any experiments utilizing the radioactive material Tc-99m were likely not occurring or on the decline. It also seems unlikely that the individual with hyperthyroidism, who worked in the electrical engineering department, was involved in Tc-99m experiments.

## VII. DISCUSSION AND CONCLUSIONS

Based on a review of all data and background information obtained about past and present SOE research activities, the lack of medically significant exposures to chemical or physical agents, and ionizing radiation measurements, the NIOSH investigators do not believe the cases of thyroid disorders reported by employees can be attributed to the physical environment in L.K. Downing Hall. The NIOSH investigators believe that radiation exposure levels associated with current SOE radioisotope research work are not an occupational health hazard.

The only possible agent identified which could be linked to the thyroid disorders was Tc-99m. Official documents indicate that this isotope was used at the SOE as part of a NRC grant; however, there was no indication in any RSO records that this isotope was used at the SOE, and none of the individuals who reported thyroid disorders could be linked to this research.

Although sampling for asbestos did not confirm the existence of airborne asbestos, bulk material samples did confirm the presence of ACM. Therefore, the potential for occupational exposures to asbestos existed in the SOE. Furthermore, the existence of badly damaged asbestos-containing steam-pipe lagging debris in the heating equipment room (G-024), the copier room (1028), and the Civil Engineering Office (1026), indicated that an effective asbestos maintenance program had not been established.

NIOSH contends there is no safe level of exposure to asbestos and recommends that occupational exposure to asbestos be controlled to the lowest feasible level. In view of the carcinogenic potential of inhaled asbestos fibers, it is important to identify its presence (or confirm its absence) and evaluate the potential for exposures to asbestos released from controllable sources. If detectable levels of asbestos are found, further evaluation of the work environment is warranted, and recommendations to reduce exposures to asbestos need to be implemented.

Additionally, evidence of the lack of effective safety and health programs and a hazard communications program was noted during our three site visits. Some of the problems identified included: (a) window coverings on several laboratory doors, prohibiting visual access, (b) unsecured or improperly secured compressed gas cylinders, (c) improper storage of spent Ni-Cd batteries, (d) improper labeling of drums of radioactive materials, (e) lack of guarding in the Robotic Laboratory, (f) lack of proper warning signs posted in laser laboratories, and (g) lack of proper eye protection in laser laboratories.

# VIII. RECOMMENDATIONS

To safeguard employee health, as stressed during our closing conferences on September 1, and 22, 1992, immediate steps should be taken to eliminate or reduce the potential for asbestos exposures. The following recommendations are offered to reduce worker exposures and improve worker safety and health at the Howard University SOE.

1. **SAFETY AND HEALTH COMMITTEE:** A safety and health committee headed by the Director of Environmental Safety and Health with faculty representatives from the School of Engineering, should be established to coordinate and administer the policies on asbestos at the School of Engineering, as well as other buildings on campus. This group should receive comprehensive training in the recognition, evaluation, and control of asbestos exposures. Training should include course work in the health hazards associated with asbestos, hazard evaluation and control techniques, and the recognition of potential asbestos-containing materials. In addition, course work and practical experience will be necessary in the subject areas of visual assessment, inspection of asbestos abatement job sites, modern abatement techniques, and the monitoring of abatement sites during and following abatement activities.

2. **ASBESTOS PROTECTION**: To minimize the chance of asbestos fiber release during asbestos-disturbing renovation or maintenance, or daily activities, a comprehensive asbestos management plan should be established for all buildings on the Howard University campus, and a comprehensive evaluation of L.K. Downing Hall should be conducted.

   Based on the existence of damaged steam-pipe lagging in the three rooms mentioned earlier in this report, an asbestos abatement project should be started at the earliest possible date. A qualified asbestos abatement contractor should be hired to conduct all abatement projects.

3. **INDOOR ENVIRONMENTAL QUALITY:** Design, maintenance, and operation of HVAC systems are critical to their proper functioning and provision of healthy and thermally comfortable indoor environments. The NIOSH/EPA document "Building Air Quality: A guide for building owners and facility managers" should be consulted for further information regarding IEQ.[14]

   a. Inspection and cleaning of all existing rooftop HVAC units should be performed monthly. A record of all cleaning and maintenance performed on the units should be kept and any potential problems identified corrected.

   b. The filter systems of all HVAC rooftop units should be inspected and upgraded to the maximum efficiency possible without affecting the HVAC system performance.

   c. The installation of HVAC units for all areas of the building for thermal comfort should be considered in the future. Many individuals indicated that thermal comfort was an issue. This situation will not be corrected until cooling is supplied throughout all occupied areas of the building.

4. **HAZARD COMMUNICATIONS:** Employee education regarding health hazards associated with the chemicals use in the workplace should be improved. Material safety data sheets **(MSDS)** for all chemicals used in the SOE should be readily accessible to all employees. The hazard communications training program should be administered according to OSHA Regulation 29 CFR 1900.1200.[15]

5. **LABORATORY SAFETY:** The window coverings on all laboratory doors and windows should be removed to provide visual access to the laboratories for overseeing the safe operation and use of the laboratories. If an individual working in the laboratory were injured and disabled, the individual may not be discovered in sufficient time to provide necessary treatment. All compressed gas cylinders must be safely secured. The SOE should continue to seek ways to remove the Pu-Be sources from the basement. The lack of appropriate guarding in the Robotic Laboratory should be evaluated.

6. **ENVIRONMENTAL TOBACCO SMOKE:** The use of tobacco products in the building may contribute to the employee complaints. Reports from the Surgeon General and the National Research Council have concluded that exposure to environmental tobacco smoke **(ETS)** may be associated with a wide range of health (e.g., lung cancer) and comfort (e.g., eye, nose, and throat irritation and odor) effects.[16-21] NIOSH has concluded that ETS may be related to an increased risk of lung cancer and possibly heart disease in occupationally exposed workers who do not themselves smoke.[22] Worker exposure to ETS is most efficiently and completely controlled by simply eliminating tobacco use from the workplace. To facilitate

elimination of tobacco use, employers should implement smoking cessation programs. Management and employees should work together to develop appropriate nonsmoking policies that include some or all of the following:

a. Howard University should institute a smoking policy that provides a smoke free environment for all employees. This recommendation is in accordance with NIOSH guidelines which recommend a smoke free environment in the workplace.

b. The most direct and effective method of eliminating ETS from the workplace is to prohibit smoking in the workplace. Until this goal is achieved, smoking should be restricted to designated smoking areas. These areas should be provided with a *dedicated exhaust system* (room air directly exhausting to the outside), an arrangement which eliminates the possibility of re-entrainment and recirculation of any secondary cigarette smoke. In addition, *the smoking area should be under negative pressure relative to surrounding occupied areas*. ASHRAE recommends that ventilation systems supplying the smoking lounge should be capable of providing at least 60 cfm of outdoor air per person.(13) This air can also be obtained from the surrounding spaces (transfer air) if it is relatively uncontaminated.

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