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FORD HOUSE OFFICE BUILDING  
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NIOSH INVESTIGATORS:  
Allison Tepper, Ph.D.  
Max Kiefer, C.I.H.  
C. Eugene Moss, H.P., C.S.S.

## I. SUMMARY

In February 1992, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) at the Ford House Office Building (FHOB) in Washington, D.C. The requestor, the Architect of the Capitol, indicated concern among staff of two legislative branch agencies about the safety of their work environment. Staff of these agencies, the Congressional Budget Office (CBO) and the House Information Systems (HIS), were apprehensive about what appeared to be an unusual number of persons with cancer, particularly brain cancer.

On 14 April 1992, NIOSH investigators conducted a site visit to the FHOB to determine whether comprehensive environmental or health studies were necessary. Because of specific concerns expressed by CBO and HIS workers, another site visit was made on 1 July 1992 to measure extremely low frequency (ELF) electric and magnetic fields in the building.

Twelve persons with cancer, including five with a brain tumor, and one person each with skin cancer, lymphoma, breast cancer, colon cancer, leukemia, esophageal cancer, and lung cancer were identified among approximately 250 persons who work in each of the two agencies. The evaluation focused on brain cancer because it was the only medical condition occurring in two or more individuals. NIOSH investigators obtained death certificates and medical records to validate the information about persons with brain cancer identified by employee representatives and reviewed the employment histories of the cancer patients. Four persons reported to have brain tumors were permanent, full-time employees of the CBO or HIS. One had a benign brain tumor, and three had medically confirmed malignant tumors. Two of the three persons with a malignant brain tumor had a primary glioblastoma (the cell type of the tumor). These individuals had been employed in the FHOB for 8 to 12 years and worked in the same office area for several years.

After a walk-through of the building, NIOSH investigators obtained and reviewed material safety data sheets for cleaning chemicals used in the Computer Center, blueprints of the complete power distribution system for the Computer Center, and reduced-scale floor plans showing the location of power cables (busduct) and frequency convertors. No obvious unusual events or activities that would indicate the presence of a health hazard to office workers in the FHOB were identified.

Exposure to 60 Hertz (Hz) electric and magnetic fields was measured on one day at 36 sites in the FHOB, including the office area occupied, at one time, by the two individuals with a primary, malignant brain tumor. The average electric field was 4.1 volts per meter (V/m) and the average magnetic field was 1.44 milligauss (mG).

There was little variation in field strength among the sites measured; the area once occupied by the two persons with a primary malignant brain tumor was similar to the other areas. The fields measured in the FHOB are relatively low, within the range of exposure levels in office settings previously reported by NIOSH and others, and are well below the current exposure criteria levels of 25,000 V/m (electric density) and 10,000 mG (magnetic flux density).

The findings of this investigation provide no basis for concluding that the cases of cancer among House Information System and Congressional Budget Office staff are related to the physical environment of the Ford House Office Building (FHOB). Although some studies suggest that brain cancer may be related to exposure to ELF electric and magnetic fields, the body of evidence is inconclusive. Moreover, the measurements made in this evaluation indicate that exposures to ELF fields in the FHOB are typical of modern office environments.

**KEYWORDS:** SIC 9121 (Legislative bodies), cancer, brain cancer, glioblastoma, ELF, E.M. radiation.

## **II. INTRODUCTION**

In February 1992, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) at the Ford House Office Building (FHOB) in Washington, D.C. The requestor, the Architect of the Capital (AOC), indicated concern among staff of two legislative branch agencies about the safety of their work environment. Staff of these agencies, the Congressional Budget Office (CBO) and the House Information Systems (HIS), were apprehensive about what appeared to be an unusual number of persons with cancer, particularly brain cancer.

On 14 April 1992, NIOSH investigators conducted a site visit to the FHOB to determine whether comprehensive environmental or health studies were necessary. Because of specific concerns expressed by CBO and HIS workers, another site visit was made on 1 July 1992 to measure extremely low frequency (ELF) electric and magnetic fields in the building.

## **III. BACKGROUND**

The FHOB is a 1,000,000-square foot, 8-story building in the central Washington, D.C. area. The FHOB was built in 1938 as a repository for fingerprint files of the Federal Bureau of Investigation. In 1974 the building was renovated by Congress for use as office space. The FHOB currently is occupied by staff of numerous Congressional agencies and committees. The CBO occupies the fourth floor, and the HIS occupies the sixth floor. Each of these agencies has an average annual employment of approximately 250.

## **IV. EVALUATION CRITERIA**

### **Electric and Magnetic Field Exposure**

The American Conference of Governmental Industrial Hygienists (ACGIH) has published Threshold Limit Values (TLVs) for sub-radiofrequency electric and magnetic fields. At 60 Hertz (Hz), which is classified as extremely low frequency, the electric intensity TLV is 25,000 volts per meter (V/m) and the magnetic flux density TLV is 10,000 milligauss (mG).<sup>1</sup>

The basis of the ELF electric field TLV is to minimize occupational hazards arising from spark sidecharge and contact current situations. The magnetic field TLV addresses induction of magnetophosphenes (a visual sensation of white light) in the visual system and production of induced currents in the body. Prevention of cancer is not a basis for either of these TLVs because exposure has not been conclusively linked to cancer.

Neither OSHA nor NIOSH have issued any criteria related to ELF exposure.

## Brain Cancer

Brain cancer is a relatively rare disease in the United States. The age-adjusted annual death rate for brain cancer between 1985 and 1987 was 4.9 deaths per 100,000 persons among males and 3.9 deaths per 100,000 persons among females.<sup>2</sup> Estimated rates of brain cancer in the United States increase with increasing age up to age 75; age-adjusted rates show an increase of 28 percent between 1973 and 1987.\*

Numerous epidemiologic studies have shown a relationship between brain cancer and exposure to chemicals in specific industries. These industries include the rubber industry, oil refineries, and various chemical industries such as polyvinyl chloride production, which share common exposures to organic solvents, lubricating oil, acrylonitrile, vinyl chloride, formaldehyde, polycyclic aromatic hydrocarbons, and phenolic compounds.<sup>3</sup> Other industries and occupations found to have elevated risks include agricultural crop production, printing and publishing, and many professional occupations such as engineers, lawyers and judges, and banking/finance managers.<sup>3,4</sup>

Attention also has been focused on reports of elevated brain cancer risk among workers in various electrical occupations that suggest a link between brain cancer and exposure to ELF electric and magnetic fields. In a January 1991 workshop sponsored by NIOSH, the epidemiologic information on the health effects of electric and magnetic fields on workers was reviewed.<sup>5</sup> For brain cancer, two types of studies provide important evidence. Among the case-control studies reviewed, most show elevated risks for electrical-related occupations, but assess exposure only indirectly. Among the cohort studies of electrical workers, risks are elevated, but many are not statistically significant despite large sample sizes and long observation periods. Other reviewers have noted further limitations to previous investigations, including the possibility that the observed effects may be due to other exposures present in the industries and occupations that have been studied or that non-occupational risk factors for brain cancer were not adequately considered.<sup>6</sup> Currently, the general consensus is that the evidence for a carcinogenic effect of exposure to ELF fields is suggestive for brain cancer but is not conclusive.

## V. METHODS

An initial site visit to the FHOB was made on 14 April 1992. An opening meeting was held with representatives of the AOC, CBO, and HIS. During this meeting, employee representatives voiced concerns about on-going evaluations of lead in the drinking water from the building's fountains. Following the meeting, a visual inspection of the fourth and sixth floors was made. NIOSH investigators looked for conditions or circumstances atypical of general office environments that might present a hazard or could possibly be related to the cancers that have occurred among the building's occupants. The inspection focused on offices in the West Wing of the building, where the majority of persons with cancer had their offices, and included the office area shared by two persons with brain cancer. The supervisor and one co-worker of one employee with brain cancer were interviewed. The inspection also included the main computer room on the sixth floor and some of the power distribution centers. The day's activities and preliminary observations were summarized in a closing conference.

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\* Estimated rates are based on data from the Surveillance, Epidemiology and End Results Program, Division of Cancer Prevention and Control, National Cancer Institute and are made available through the Information Resources Management Office of the Centers for Disease Control.

Following the first site visit, NIOSH investigators obtained death certificates and medical records to validate the information about persons with brain cancer identified by CBO and HIS staff. Staff Directors of two other agencies that occupy the building were also contacted. These agencies, the Select Committee on Narcotics Abuse and Control (SCNAC) and the Commission on Security and Cooperation in Europe (CSCE), had expressed interest in the NIOSH evaluation. NIOSH investigators also obtained and reviewed material safety data sheets (MSDSs) for cleaning chemicals used in the Computer Center, blueprints of the complete power distribution system for the Computer Center, and reduced-scale floor plans showing the location of power cables (busduct) and frequency convertors.

A second site visit was made on 1 July 1992. Exposure to 60 Hz electric and magnetic fields was measured using a Holaday Industries, Inc. (HI) Extremely Low Frequency (ELF) Sensor (Model HI-3602) connected to a HI-3600 meter. The electric field strength is measured as V/m and the magnetic field strength is expressed in units of mG. All measurements were made during daylight hours at waist height. Where possible, at least two readings were taken at each location with the Holaday monitors and the average reading was recorded. All systems were calibrated either by NIOSH or the manufacturer within six months of the date of this evaluation. The limited number of measurements taken was not intended to represent an in-depth evaluation of the radiation fields at the site, but rather to approximate workplace exposure levels found on the days of measurement.

## **VI. RESULTS**

### **Cancer Occurrence**

Information provided with the original request indicated that nine employees had been diagnosed with various types of cancer. More specific information obtained from the Personnel Officers of the CBO and HIS indicated a total of 12 persons with cancer, including five with a brain tumor, and one person each with skin cancer, lymphoma, breast cancer, colon cancer, leukemia, esophageal cancer, and lung cancer. No additional cancer cases were identified by the staff directors of the SCNAC and the CSCE.

Four of the five persons reported to have brain tumors were permanent, full-time employees of the CBO or HIS. The fifth was a computer equipment service representative who spent part of his time in the Computer Center. No additional information was obtained about this individual. Among the four CBO/HIS employees with brain tumors, one was reported to have a benign tumor and three were found to have had a malignant tumor. Information obtained from death certificates and medical records confirmed the occurrence of the three malignant tumors. In one of these three persons, this additional information indicated that the primary cancer was melanoma, which metastasized to the lung and brain. For the two persons with a diagnosis of a primary, malignant brain tumor, histological information indicated a glioblastoma.

Work histories of the two individuals with a primary, malignant brain tumor indicated that they had been employed in the FHOB for 8 to 12 years. Both had worked in office environments prior to their employment at the FHOB. These individuals worked in the same office area in the FHOB for several years.

### **Facility Inspection**

#### *General Office Space*

The FHOB has eight heating, ventilating and air-conditioning (HVAC) systems, all of which were installed in the 1970s and are located in a penthouse. These are variable-air-volume

systems serving eight vertical zones in the building. On each floor, the area above the false ceiling serves as a plenum for return air. With the exception of two basement areas, outside air is provided from intakes on the roof. There are no cooling towers on the roof of this building. Chilled water is supplied from a central plant. Mechanical systems such as chilled water storage and distribution are located in the basement. Building power is supplied from transformers located in the basement.

An inspection of fourth and sixth floor offices, primarily in the West Wing, did not reveal any unusual conditions or atypical activities. The offices housed one or more employees and appeared uncrowded. Most offices had windows that could be opened by occupants. Most workers had a personal computer or video display terminal on their desk.

In one office, air supply diffusers had been left uncleaned for the inspection. Small black particles were noted on the diffuser and surrounding ceiling area, as well as on the employee's desk.

There is some asbestos insulation in the basement of the building. According to AOC personnel, however, there is no asbestos present above the false ceilings. AOC representatives indicated that air monitoring conducted throughout the building revealed no asbestos problem. (NIOSH investigators did not review the results of this monitoring.)

#### *Computer Center*

The HIS Computer Center on the sixth floor houses a mainframe computer system that supports all functions of the House of Representatives. The system supports up to 8000 on-line users. The center, which contains computers, compilers, tape storage, and printers, is a dedicated, environmentally-controlled area encompassing about 12,000 square feet. Approximately 25 people work in this area. Smoking is not permitted and access is limited for security reasons.

Power is supplied to the Computer Center from a switchboard in the basement through a busduct (2000 amperes) to the seventh floor converter room switchboard (480 volts). The busduct traverses vertically through a chase in the center of the building on the east side. The present load carried by the busduct is 400 amperes. The seventh floor converter room, which is located directly above the entrance to the Computer Center, contains an uninterruptible power supply and frequency converters. Prior to December 1991, the frequency converters were used to provide 415 Hz power for the central processing unit (CPU). These converters are no longer needed because the new CPU uses standard 60 Hz power. Prior to 1985, the frequency converters and associated transformers were located on the fifth floor under the Computer Center.

Several electrical closets located throughout the Computer Center contain circuit breaker panels and transformers. These electrical closets support various items of equipment, including the Computer Center's dedicated air handling units.

#### *Electric and Magnetic Field Exposure in the Building*

Levels of ELF electric and magnetic fields are shown in Table 1 for the hall and office areas measured in the building. The electric field measurements ranged from 3.4 to 8.4 V/m (average=4.1), and magnetic field measurements ranged from .46 to 6.80 mG (average=1.44). Waveforms were analyzed at several sites in the hall and office spaces. Several different waveforms were captured by the Holaday meter and displayed on a digital oscilloscope. They were of the normal sinusoidal varying 60 Hz type.

Table 1

Measurements of Extremely Low Frequency Electric and Magnetic Fields  
 Ford House Office Building: 1 July 1992

Location*	N	Electric field (V/m)			Magnetic field (mG)		
		Min.	Max.	Avg.	Min.	Max.	Avg.
6th floor hall	14	3.1	5.1	3.5	0.52	1.45	0.89
4th floor hall	8	3.2	8.4	4.0	0.46	1.50	0.92
4th floor offices	12	3.4	8.3	5.0	0.50	6.80	1.82
Totals	34	3.1	8.4	4.1	0.46	6.80	1.44

\* All measurements were made in the west wing of the building.

In addition to the measurements shown in Table 1, limited measurements were made in the Computer Center and in rooms located behind the 4th floor elevators. Magnetic fields ranged from 0.4 to 66 mG in the Computer Center and measured 0.5 mG behind the elevators. Electric fields behind the elevators measured 3.1 V/m.

Sources of ELF field exposure were prevalent throughout the 4th, 5th, and 6th floors of the FHOB. These sources included the items listed below.

electric hole puncher	various electric lamps
wall and desk clocks	AM/FM radios
crock pots	computer plotters
microwave ovens	toasters
electric space heaters	coffee pots
water dispensers	photocopy machines
television sets	video display terminals
FAX machines	electric calculators
refrigerators	aquarium pumps
electric blenders	video cassette recorders
electric pencil sharpeners	wall and desk fans
microfiche machines	dictaphones
electric mailers	Christmas tree lights (on)
electric typewriters	plant grow lamps
power strips	electric staplers

#### *Chemical Usage in the Building*

According to AOC representatives, all transformers in the building are free of polychlorinated biphenyls. There are no laboratories or other areas where chemicals are routinely used in the building. Various small (<1 pint) containers of cleaning fluids were found in one file cabinet in the computer equipment vendor office located within the Computer Center. These materials are used sporadically in small quantities by the service representative. A review of the MSDSs for these materials indicated that the following two products contained potential carcinogens:

1. IBM Cleaner, Cleaning Fluid P/N 0450608: This material contains 2% by volume of 1,4-dioxane (CAS 123-91-1), a volatile colorless liquid. 1,4-dioxane is listed by the International Agency for Research on Cancer (IARC) and the National Toxicology

Program (NTP) as a potential carcinogen.<sup>7,8</sup> 1,4-Dioxane has been linked with lung, nasal, liver, and gallbladder cancer, and as a promoter of skin cancer. NIOSH considers 1,4-dioxane a potential occupational carcinogen and recommends controlling exposure to the lowest feasible limit.<sup>9</sup>

2. IBM Loctite, Adhesive, Megabond Rapid Cure Epoxy Hardener P/N 83X9295: This material contains 3% by weight of styrene monomer (CAS 100-42-5), which is listed by IARC as a potential carcinogen.<sup>7</sup>

## VII. DISCUSSION AND CONCLUSIONS

Cancer is a group of diseases that share a common feature, the uncontrolled growth and spread of abnormal cells. Cancer is common in the United States. About one in three people will eventually develop cancer. One of every five deaths is from cancer. Among adults, cancer occurs more frequently among men than among women, and the rate of occurrence increases with increasing age.<sup>2</sup>

Cancers often appear to occur in clusters. Cases that are close together in time or space (for example, a neighborhood or workplace) may have a shared cause or may represent the coincidental occurrence of unrelated causes. The number of cases may seem high, particularly among the small group of people who have something in common with the cases, such as working in the same building. Even if the number of cases represents a statistically significant excess, this may not indicate a causal link to the workplace environment. When a small number of cases occurs it usually is difficult to determine whether they have a common cause. This is especially true for cancer cases that occur among workers in non-industrial settings, where a biologically significant exposure may be difficult to identify.

Several different types of cancer were found in this investigation. Because most cancer-causing substances are known to cause only one or two different types of cancer, the overall pattern of cancers among employees did not suggest any specific cancer-causing agent common to all affected individuals. There were, however, five reported cases of brain cancer. No information was obtained about the one individual who worked only part-time in the building as a service representative. Among the remaining four persons, only two were confirmed to have a malignant tumor with the brain as the primary site. When evaluating the role of exposure to hazardous agents in the development of cancer, investigators usually consider only malignant, primary tumors; other tumors may represent different pathophysiologic processes. The occurrence of two cases in which the brain was the primary cancer site could be either a coincidental occurrence or the result of common exposure.

Most cancers require a period of 10 to 30 years from the time of first exposure to the causative agent to clinical detection. Neither of the persons with primary brain cancer worked in the FHOB for more than 12 years.

NIOSH investigators did not identify any obvious unusual events or activities that would indicate the presence of a health hazard to office workers in the FHOB. The particulate residue detected on the air supply diffusers and surrounding areas is commonly observed in many office environments with HVAC systems. These particles, possibly carbonaceous (soot) in origin, may have come from the air supply or from the office area, possibly adhering to the ceiling and diffuser area due to electrostatic charges. Lead in drinking water may be a health hazard depending on the extent of exposure, but it has not been shown to be a cause of brain cancer. Asbestos also has not been shown to be a cause of brain cancer. Due to the low concentrations, small volumes, and limited use of the IBM cleaning and bonding materials, exposures to these substances is not widespread and,



therefore, could not explain the multiple cases of brain cancer (even if they, or similar chemicals, were used in the same manner years ago).

All levels of ELF electric and magnetic fields measured inside the building are relatively low, within the range of exposure levels in office settings previously reported by NIOSH and others, and are well below current occupational exposure criteria. Measurements made in the office area shared for some time by the two individuals with a primary, malignant brain tumor did not reveal exposures significantly different than in other areas.

Although employees may be concerned about levels of exposure below the established criteria, there is currently no conclusive evidence to show that chronic exposure to 60 Hz fields causes adverse human effects. It should be noted, however, that research suggests that health effects related to ELF fields are linked to many variables, of which field strength is only one. Therefore, depending on these variables, weaker electric or magnetic fields are not necessarily safer than stronger fields.

Based on the information discussed above, it appears unlikely that the cases of cancer among HIS and CBO staff are related to the physical environment of the FHOB. Although some studies suggest that brain cancer may be related to exposure to ELF electric and magnetic fields, the body of evidence is inconclusive. Moreover, the measurements made in this evaluation indicate that exposures to ELF fields in the FHOB are typical of modern office environments.

## **VIII. RECOMMENDATIONS**

Although the levels of ELF electric and magnetic fields measured in the FHOB are relatively low, exposure to building occupants could be reduced. Management of the CBO indicated that older video display terminals were being replaced by newer, state-of-the-art equipment that minimizes electric and magnetic field output. Continuation of these efforts is appropriate. In addition, NIOSH investigators observed a wide range of items contributing to total exposure. Many items, such as video display terminals and photocopier machines, are essential to the modern office environment. Others, however, could be considered "non-essential" and their presence should be re-evaluated by employees concerned about their overall exposure to ELF electric and magnetic fields in the office. Electromagnetic field strength decreases in proportion to the square of the distance from the source. Thus, while "non-essential" sources in an employee's own work space may be relevant to his or her total exposure, such sources in a neighbor's work space should be of much less concern.

There is a high level of concern and anxiety among building occupants as a result of recent testing for lead content of water in the drinking fountains. It appears that some of this anxiety could be reduced by improved communication. The NIOSH investigators recommend that a mechanism be established to keep all employees fully informed of the plans for testing the water, of the results of all tests, and of the plans for implementing corrective measures.

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**X. AUTHORSHIP AND ACKNOWLEDGEMENTS**

Report Prepared by: Allison Tepper, Ph.D.  
Supervisory Epidemiologist  
Medical Section  
Hazard Evaluations and Technical Assistance Branch

Max Kiefer, C.I.H.  
Industrial Hygienist  
Atlanta Regional Office

C. Eugene Moss, H.P., C.S.S.  
Health Physicist  
Industrial Hygiene Section

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

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