HETA 86-092-1870
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50 STANIFORD STREET OFFICE BUILDING
BOSTON, MASSACHUSETTS

NIOSH INVESTIGATOR:
John R. Kominsky, M.Sc., CIH

I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) was requested by a property management company to design and implement a test plan to determine, subsequent to decontamination of the upper basement through floors four of the 50 Staniford Street Office Building in Boston, whether the residual concentrations of polychlorinated biphenyls (PCBs), polychlorinated dibenzofurans (PCDFs), and polychlorinated dibenzo-p-dioxins (PCDDs) are below acceptable guidelines. This building experienced a transformer fire in October 1981. The guidelines selected by the NIOSH investigators were derived from a similar evaluation in New Mexico. They were: PCBs = 0.5 ug/m^3 in air and 50 ug/m^2 on surfaces; PCDFs/PCDDs converted to 2,3,7,8-tetrachlorodibenzo-p-dioxin equivalents = 2 pg/m^3 in air and 1 ng/m^2 on surfaces.

The building was divided into three strata: one = floors 2 - 4; two = floor 1; and three = upper basement. A test plan based on best engineering judgement (BEJ) and weighted random sample (WRS) strategies was used to determine the residual contamination levels. The BEJ approach suggests sample locations based on judgmental factors as to where exposures are likely to be highest; whereas, WRS sampling is statistical random sampling of locations. The WRS approach allowed for a statistical statement as to the confidence in the decontamination of the untested areas. The WRS data was used to compute, for each strata, a 95%-95% upper tolerance limit, Tl. This tolerance limit is a value for which there is 95% confidence that the probability of the PCB concentration for any randomly selected location in the building exceeding the value of Tl is less than 5%. Each stratum was tested to determine the air and surface concentrations of PCBs, PCDFs, and PCDDs; the interior surfaces of the heating, ventilation, and air-conditioning (HVAC) system also were tested.

The analysis of 16 samples for PCBs showed that the residual air concentrations in the building ranged from none-detected (<0.02 ug/m^3) to 0.46 ug/m^3 with an arithmetic mean of 0.11 ug/m^3. The analysis of 12 samples for PCDF/PCDDs (converted to 2,3,7,8-TCDD equivalents) ranged from 0.003 to 1.7 pg/m^3 with an arithmetic mean of 0.40 pg/m^3. The analysis of 339 samples for PCBs collected on building surfaces showed 32% (109/339) of the samples were none-detected; 67% (228/339) contained measurable concentrations <25 ug/m^2; and 1% (2/339) ranged between 25 ug/m^2 to <50 ug/m^2; and 0% exceeded the 50 ug/m^2 guideline. The calculated (95%,95%) upper tolerance limits for each stratum were: 15.3 ug/m^2 for floors 2 - 4; 9.7 ug/m^2 for floor 1; and 5.2 ug/m^2 for the upper basement. The analysis of 58 samples collected on interior HVAC system surfaces showed 19% (11/58) of the samples were none-detected; 78% (45/58) contained measurable concentrations of <25 ug/m^2; 2% (1/58) ranged from 25 to <50 ug/m^2; and 2% (1/58) exceeded 50 ug/m^2. The analysis of 12 samples for PCDF/PCDDs (converted to 2,3,7,8-TCDD equivalents) ranged from 0 to 2.7 ng/m^2, with two values exceeding the 1 ng/m^2 guideline. One of the samples (1.2 ng/m^2) was collected on a wood paneled wall in the first floor lobby; the paneling has been removed. The other (2.7 ng/m^2) was collected on the floor of the transformer vault; the floor has since been encapsulated.

Based upon these results, it is concluded that the residual concentrations of PCBs, PCDFs, and PCDDs in air and on surfaces in the upper basement through floors four are below the cleanup guidelines. Therefore, it is concluded that these areas are acceptable for occupancy.

KEYWORDS: SIC 9199 (Office Building), polychlorinated biphenyls, PCBs, polychlorinated dibenzofurans, PCDFs, polychlorinated dibenzo-p-dioxins, PCDDs, transformer fire.

II. INTRODUCTION

On December 16, 1985, the National Institute for Occupational Safety and Health (NIOSH) was requested by Charles River Park Properties to design and implement a test plan to determine, subsequent to decontamination of the upper basement through floors four of the 50 Staniford Street Office Building in Boston, whether the residual concentrations of polychlorinated biphenyls (PCBs), polychlorinated dibenzofurans (PCDFs), and polychlorinated dibenzo-p-dioxins (PCDDs) in these areas are below acceptable guidelines. The building experienced an electrical transformer fire in October 1981.

On February 21 - 23, 1986, NIOSH with assistance from the Division of Occupational Hygiene of the Commonwealth of Massachusetts and SOS International implemented a test plan to determine the effectiveness of the cleaning of floors one through four. The results of the February 1986 test were reported to Charles River Park Properties (the building property management company) in an Interim Test Report dated May 30, 1986. On January 22 - 23, 1987, NIOSH implemented a test plan to determine the effectiveness of the cleaning of the upper basement, and that the contamination levels on the first floor were still below acceptable guidelines as demonstrated by the February 1986 test.

This final report presents the complete results for the February 1986 and January 1987 tests and concludes that the 50 Staniford Street Office Building is acceptable for occupancy.

III. BACKGROUND

On October 25, 1981, a fire occurred in an electrical transformer located in the upper basement of the 50 Staniford Street Office Building in Boston, Massachusetts. The transformer contained a coolant liquid consisting of Aroclor 1254 (a commercial mixture of polychlorinated biphenyls with approximately 54% chlorine by weight). The resultant combustion soot containing polychlorinated biphenyls (PCBs) and pyrolysis products including polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzo-p-dioxins (PCDDs) was transported by both mechanical and natural ventilation throughout the upper basement, and possibly other areas of the building. A contractor removed the heavy soot deposits in the upper basement area; painted the wall, ceiling and floor surfaces; and replaced the contaminated ventilation ducts. In June 1985 a new tenant, prior to occupying floors two through four of the 50 Staniford Street Office Building, retained a consultant to conduct limited testing to assure that these areas were not contaminated with residual PCBs and PCDFs. The testing was limited to the upper basement and floor two. The results of the test [1] and further testing conducted in July 1985 [2] indicated that the upper basement and floor two were contaminated with low levels of PCBs and PCDFs. These results prompted Charles River Park Properties to retain another environmental engineering consultant to conduct a comprehensive contamination assessment study of the 50 Staniford Street Office Building. This study was conducted during October 12 - 20, 1985, and the results were submitted to NIOSH for review in December 1985 [3].

Review of the October 1985 test results by NIOSH [4] showed the following: (1) The lower basement was not contaminated with measurable air and surface concentrations of PCBs, PCDFs, and PCDDs above acceptable guidelines (see Part III of this report). (2) The upper basement was contaminated with PCBs, PCDFs, and PCDDs; maximum air and surface concentrations were present in the restricted access areas including the transformer vault and switchgear rooms. (3) The first floor lobby and first floor were contaminated with low concentrations of PCBs and, to a lesser extent PCDFS and PCDDs. The surface and air concentrations of PCDFs and PCDDs did not exceed the acceptable guidelines (see Section III), but did demonstrate migration from the source areas in the upper basement. The surface concentrations of PCBs that exceeded the guidelines were limited to areas not normally accessible to skin contact; all PCB air concentrations were below the guidelines. (4) Testing was not conducted on floors two through four, as these floors were considered to be contaminated with low levels of these contaminants based on the June and July 1985 test results. (5) Floors five through ten were not contaminated with PCBs, PCDFs, or PCDDs above the guidelines.

Based upon these results, floors one through four were cleaned between November 1985 and January 1986, and the upper basement between January and December 1986.

IV. CLEAN-UP GUIDELINES

The guidelines selected by the NIOSH investigators for evaluating the building were the same as those recommended by the Governor-appointed Advisory Panel for certification of the New Mexico State Highway Department (NMSHD) Building in Santa Fe, New Mexico [5]; the NMSHD Building experienced an electrical transformer malfunction on June 17, 1985 [6]. The Panel consisted of representatives of NIOSH, U.S. Environmental Protection Agency, Workers Institute for Safety and Health, and four members of New Mexico's scientific community.

The clean-up guidelines established by the New Mexico Advisory Panel were based on the maximum levels of PCBs, PCDFs, and PCDDs that would not result in a significant human health risk if a person were exposed to these levels for a working lifetime of 30 years. The guidelines for PCDFs and PCDDs were intended to maintain the risk of developing cancer below one in one million for a person spending a working lifetime (30 years) in the building. The guidelines for PCBs took into account the usual presence of detectable background levels of PCBs in air [7] and on surfaces [8] and were intended to guide the cleanup within a safe margin of this background level.

The surface and air guidelines recommended by the Panel are shown below:

	AIR	SURFACE
PCBs	0.5 ug/m^3	50 ug/m^2
2,3,7,8-TCDD Equivalents	2 pg/m^3	1 ng/m^2

Units:
ug/m^3 = micrograms of PCB per cubic meter of air.
pg/m^3 = picrograms of 2,3,7,8-TCDD Equivalents per cubic meter of air.
ug/m^2 = micrograms of PCB per square meter of surface.
ng/m^2 = nanograms of 2,3,7,8-TCDD Equivalents per square meter of surface.

The potential toxicity of the PCDF and PCDD mixtures was assessed based upon the calculated concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin equivalents (2,3,7,8-TCDD equivalents). This procedure, first proposed by the New York State Department of Health [9], permits calculation of the amount of 2,3,7,8-TCDD that would have to be present to exhibit the same toxicity as the measured quantities of each of the various PCDFs and PCDDs that are present, and the summation of these calculated amounts of 2,3,7,8-TCDD equivalents is an estimate of the total TCDD equivalent toxicity of the mixture. This procedure assigned toxicity weighting factors equal to the relative toxicity of the various PCDFs and PCDDs chlorinated in the 2,3,7,8-positions as compared to the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin. The U.S. EPA reviewed the available data on toxicity of these chemicals, and has recommended toxicity equivalence factors (TEFs) for calculating the 2,3,7,8-TCDD equivalence of a mixture of PCDDs and PCDFs [10]. The TEFs used to calculate the 2,3,7,8-TCDD equivalents are listed below:

PCDDs	TEF	PCDFs	TEF
2,3,7,8-TCDD	1.0	2,3,7,8-TCDF	0.1
other TCDDs	0.01	other TCDFs	0.001
Total PeCDDs	0.5	Total PeCDFs	0.1
Total HxCDDs	0.04	Total HxCDFs	0.01
Total HpCDDs	0.001	Total HpCDFs	0.001
OCDD	0	OCDF	0

V. SAMPLING PLAN DESIGN AND METHODS

A. Sampling Plan Design

The objective of the sampling plan was to determine the residual air and surface concentrations of PCBs, PCDFs, and PCDDs within the upper basement through floors four of the 50 Staniford Street Office Building, and compare these concentrations to the cleanup guidelines described in Part III of this report.

The building was divided into three strata: One included floors two through four (Figures 1 - 3); two included the first floor and lobby (Figure 4); and three the upper basement (Figure 5). Strata one and two were tested during February 21 - 23, 1986; strata three was tested during January 22 - 23, l987. The January 1987 tests also included retesting of the air on floors one through four for PCBs, and surfaces on floor one for PCBs, PCDFs, and PCDDs. The air was retested because the laboratory generated quality assurance samples showed concentrations of PCBs comparable to that present for the actual building air samples. The surfaces on the first floor were retested to verify that the remediation efforts in the upper basement between January 1986 and December 1986 did not contaminate this area.

A test plan based on best engineering judgement (BEJ) and weighted random sample (WRS) sampling strategies was used to determine the residual contamination levels in each of the three strata [11]. The BEJ approach suggests sample locations based on judgmental factors as to where exposures are likely to be highest; whereas, WRS sampling is statistical random sampling of locations. The BEJ approach was used to select locations for PCB, PCDF, and PCDD air and surface samples. The WRS approach was limited to selecting locations for PCB surface samples. The integration of these two approaches provided a set of test results that allowed a determination of the building cleanliness on both an engineering and statistical basis [5,11]. Further details are present in Appendix I.

B. Sampling and Analytical Methods

a. Air Sampling - PCBs, PCDFs, and PCDDs

Air samples for PCBs were collected using a modification of a florisil stick procedure developed by the NEW York State Department of Health. The New York State Florisil (NYSF) stick procedure was modified by trapping airborne particulates on a 47-mm, 0.3 um pore size glass fiber filter before collecting the vapor phase on the florisil. This modification is consistent with NIOSH Method 5503 [14].

The NYSF stick is a glass tube 9.5 inches long by 0.375 inches outside diameter. This tube contains two sections (front and back) of 400 mg of 30/60 mesh florisil adsorbent. The front and back are separated by two plugs of glass wool. The two stage sampling device was attached to a 1.5 cfm rotary vane pump operating at 110 VAC line power. The air samples were collected for approximately a 50 hour period at a flow rate of 1.0 L/min using an "in-line" calibrated rotameter and a precision flow control valve. The samplers were inspected approximately every six hours and flow rates recorded and adjusted as necessary.

Air samples for PCDFs and PCDDs were collected using a high volume sampling device developed by the New York State Health Department (NYSDH) [15].

The high volume sampler is a two stage sampling device. The first stage is a 47-mm diameter, 0.3 um pore size glass fiber filter. The second stage is a cartridge of 8 gms of silica gel adsorbent. The silica gel cartridge was spiked with 2.5 ng each of 2,3,7,8-tetrachlorodibenzo-p-dioxin-$^{13}C_{12}$ and 2,3,7,8-tetrachlorodibenzofuran-$^{13}C_{12}$ before sampling for quantification and to account for any retention losses during sampling.The sampler was attached to a 1.5 cfm rotary vane vacuum pump operated on 110 VAC line power. The air sample was collected for approximately a 50 hour period at a flow rate of 20 liters per minute (L/min) to achieve an air volume of approximately 57.6 cubic meters of air. The air flow rate through the samples was regulated to 20 L/min using an "in-line" calibrated rotameter and a precision flow control valve. The samplers were inspected approximately every six hours and flow rates recorded and adjusted as necessary.

b. Surface Sampling - PCBs, PCDFs, and PCDDs

A wet wipe protocol was used to assess the surface concentrations of PCBs, PCDFs, and PCDDs. The surface wipe samples were collected using 3" x 3" soxhlet extracted cotton gauze pads. The sampling procedure consisted of marking off a surface into 0.25 m^2 areas using a galvanized steel template or a metal tape measure. Each 0.25 m^2 area was wiped with a 3" x 3" gauze pad which had been wetted with 8 ml of pesticide grade hexane. The wet wipe sample pad was held with a glove hand; a non-linear polyethylene, unplasticized type glove was changed with each sample. The surface was wiped in two directions (the second direction was performed at a 90 degree angle to the first direction). Each gauze pad was used to wipe only one 0.25 m^2 area. The gauze pad was then placed in a glass sample container equipped with a Teflon lined lid.

Each PCB wipe sample consisted of a single sample from an area of 0.25m^2. Each PCDF and PCDD wipe sample consisted of a composite of four 0.25m^2 wipe samples for a total area of 1.0 m^2. The four PCDF and PCDD gauze pads were composite and treated as a single sample to attain an acceptable detection limit. Details of sample analysis are contained in Appendix II.

c. Sample Chain-of-Custody

Sample Chain-of-Custody procedures were an integral activity of both sampling and analytical activities. Chain-of-Custody procedures provided documentation of samples through all phases of activities from the time the sampling devices were prepared to be sent to the field through reporting of the analytical results. Sample Chain-of-Custody was initiated by the sampling personnel upon receipt of the sampling devices.

The Chain-of-Custody procedures were in accordance with those specified in NIOSH's manual of Standard Operating Procedures for Industrial Hygiene Sampling and Chemical Analyses, SOP No. 019, December 19, 1984.

VI. RESULTS AND DISCUSSION

A. PCBs on Building and HVAC System Surfaces

a. PCBs on Building Surfaces

A total of 339 wipe samples (Tables 1 and 2) were collected on building surfaces for the analysis of PCBs. Building surfaces included walls, floors, ceilings, and miscellaneous office furniture (desks, tables, cabinets, etc.). Figure 6 shows that approximately 32% (109/339) of the samples were none-detected; 67% (228/339) contained measurable concentrations below 25 ug/m^2; 1% (2/339) ranged from 25 to <50 ug/m^2; and 0% exceeded the 50 ug/m^2 cleanup guideline.

The 339 sample results are summarized by location and type of sample (weighted random or best engineering judgement) in Table 3. A total of 89 weighted random samples were collected on floors 2 - 4, with an average value of 2.2 ug/m^2 and a maximum value of 22 ug/m^2. The W-test for the log-normal distribution gave a value of z = -2.51, and the 5% rejection criterion for the log-normal distribution was
$z < -2.58$ or $z > 1.27$. Hence we failed to reject the log-normal distribution. The calculated 95%-95% upper tolerance limit is 15.3 ug/m^2, which is below the guideline of 50 ug/m^2. A total of 60 weighted random samples were collected on the first floor and lobby, with an average value of 1.8 ug/m^2 and a maximum value of 13 ug/m^2. The W-test for the log-normal distribution resulted in a z = -2.59, and the 5% rejection region for the log-normal distribution was $z < -2.67$ or $z > 1.12$. Hence, we failed to reject the log-normal assumption. The 95%-95% upper tolerance limit is 9.7 ug/m^2. A total of 93 weighted random samples were collected in the upper basement with an average value of 1.5 ug/m^2 and a maximum value of 48 ug/m^2. The second largest value of 5.2 ug/m^2 indicates the "outlying" nature of the one observation (48 ug/m^2). The W-test resulted in a z = -4.4, and the 5% rejection region was $z < -2.58$ or $z > 1.27$. Hence, the log normal distribution is rejected and a non-parametric tolerance limit is used. The 95%-95% tolerance limit is the second largest order statistic, 5.2 ug/m^2.

The average and maximum values determined for the samples collected using best engineering judgement (Table 3) were: 1.9 and 8.0 ug/m^2 for floors 2 - 4; 2.5 and 34 ug/m^2 for floor 1 and the lobby; and 0.4 and 0.9 ug/m^2 for the upper basement.

In summary all PCB surface concentrations were below the cleanup guideline of 50 ug/m^2, Therefore, it is

concluded that the building surfaces in the upper basement through floors four have been effectively cleaned to the guideline specified for PCBs on surfaces.

b. PCBs on Interior HVAC System Surfaces

A total of 58 wipe samples (Tables 1 and 2) were collected on interior HVAC system surfaces for PCB analysis. The results are summarized in Table 4. Figure 7 shows that approximately 19% (11/58) of the samples were none-detected; 78% (45/58) contained measurable concentrations of <25ug/m^2; 2% (1/58) ranged from 25 to <50 ug/m^2; and 2% (1/58) exceeded 50 ug/m^2. All of the samples showed concentrations below the 50 ug/m^2 guideline, except one. This sample (88 ug/m^2) was collected in February 1986 on the exterior fresh air intake louvers above the South entrance to the building. The louvers and supply air ventilation duct were cleaned by the contractor. The followup testing conducted in January 1987 (Table 2 and Figure 8) show that all HVAC system surfaces are within the guidelines.

B. PCDFs and PCDDs on Surfaces

A total of 12 surface wipe samples were collected for analysis of tetra- through octa-chlorinated dibenzofuran (PCDF) and dibenzo-p-dioxin (PCDD) homologs, and the respective 2,3,7,8-tetra CDF and CDD isomers (Tables 5 and 6). (Two quality control field blank samples also were included.) Eleven of the 12 samples were collected on building surfaces; and one sample was collected on an interior HVAC system surface in the upper basement. The calculated surface concentrations of total 2,3,7,8-TCDD equivalents (Table 7) ranged from 0 to 2.7 ng/m^2, with two values exceeding the 1 ng/m^2 guideline. One of the samples (#504, 1.2 ng/m^2) was collected on a wood paneled in the lobby of the first floor; all of the paneling in the lobby has since been replaced. The other sample (#511, 2.7 ng/m^2), was collected on the floor in the transformer vault; this surface has since been encapsulated with an epoxy-elastomeric encapsulant.

C. PCBs in Air

A total of 28 air samples were collected for the analysis of PCBs (Tables 8 and 9). Eight of these samples were collected in February 1986 (Table 8). The airborne concentrations ranged from 0.15 to 0.24 ug/m^3; however, the quality assurance samples also showed contamination (Table 8). Although the eight air samples showed concentrations below the 0.5 ug/m^3 guideline, these data were considered to be unacceptable and these area were retested as part of the January 1987 test.

In January 1987 the upper basement through fourth floor was tested at 16 locations; duplicate samples were collected of the air entering the building (Table 9). Five of the 16 samples collected in the building showed concentrations above the detection limit. Overall, the building air concentrations ranged from none-detected (<0.02 ug/m^3) to 0.46 ug/m^3 with an average value of 0.11 ug/m^3; all values are below the guideline of 0.5 ug/m^3.

D. PCDFs AND PCDDs in Air

A total of 14 air samples were collected for the analysis of tetra- through octa-chlorinated dibenzo-p-dioxin (PCDDs) and dibenzofuran (PCDF) homologs, and the respective 2,3,7,8-tetra CDD and CDF isomers (Tables 10 and 11). (Two quality assurance field blanks also were collected.) Twelve of the 14 samples were collected in the occupied workspace of the building and two samples were collected at the fresh air intake plenum of the building.

The calculated surface concentrations of total 2,3,7,8-TCDD equivalents (Table 12) ranged from 0.003 to 1.7 pg/m^3 with an average value of 0.40 pg/m^3. The two ambient air samples showed concentrations of 0.07 and 0.21 pg/m^3. All values are below the cleanup guideline of 2 pg/m^3.

VII. CONCLUSIONS

The National Institute for Occupational Safety and Health (NIOSH) was requested by Charles River Park Properties, Inc. to design and implement a test plan to determine, subsequent to decontamination of the upper basement through floors four of the 50 Staniford Street Office Building in Boston, that the residual concentrations of polychlorinated biphenyls (PCBs), polychlorinated dibenzofurans (PCDFs), and polychlorinated dibenzo-p-dioxins (PCDDs) in these areas are below acceptable guidelines. The guidelines selected by the NIOSH investigators for the building were the same as those recommended by the Governor-appointed Advisory Panel for certification of the New Mexico State Highway Department Building in Santa Fe, New Mexico; the State Highway Department Building experienced an electrical transformer malfunction in June 1985.

On February 21 - 23, 1986, NIOSH with assistance from the Division of Occupational Hygiene of the Commonwealth of Massachusetts and SOS International implemented a test plan to determine the effectiveness of the cleaning of floors one through four. On January 22 - 23, 1987, NIOSH implemented a test plan to determine the effectiveness of the cleaning of the upper basement.

The results of these tests show that the residual concentrations of PCBs, PCDFs, and PCDDs in air and on surfaces in upper basement through floors four are below the cleanup guidelines. Therefore, under the conditions of these contaminants measured, it is concluded that the upper basement through floors four of the 50 Staniford Street Office Building are acceptable for occupancy.

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

John R. Kominsky, M.Sc., CIH
Hazard Evaluation and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio 45226

Evaluation Conducted by:

John R. Kominsky, M.Sc., CIH
National Institute for Occupational Safety and Health
Cincinnati, Ohio 45226

Wesley E. Straub and Kevin P. McManus
Region I, National Institute for Occupational Safety and Health
Boston, Massachusetts

Joan N. Parker, M.Sc., CIH and Elice Morse
Dept. of Labor and Industries Commonwealth of Mass.
West Newton, Massachusetts

Donald Nalls, Patrick O'Neil,
Christopher Kwoka, P.E., William Upton,
Brenda Lothridge, Holli Rauvola,
James Newcomb, and Linda Newcomb
Environmental Engineering Division,
S0S International, South San Francisco, CA

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Originating Office:

Hazard Evaluations and Technical Assistance Branch
National Institute for Occupational Safety and Health
Cincinnati, Ohio

X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH publications office at the Cincinnati address.

Copies of this report have been sent to:

1. Charles River Park Properties, Inc., Boston, Massachusetts.
2. SOS International, South San Francisco, California.
3. NIOSH Boston Region
4. OSHA Region I
5. U.S. EPA Region I

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.

Table 1
Surface Concentrations of Polychlorinated Biphenyls
50 Staniford Street Office Building
Boston, Massachusetts
February 21 - 23, 1986

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP1001 (V-50)	Lobby: outside fresh air intake louvers above south entrance	88.0[a]
WP1002 (E-36)	2nd floor: column in SE quad	5.2[a]
WP1003 (R-207)	2nd floor: floor in SE quad	14.0
WP1004 (R-205)	2nd floor: face of perimeter HVAC unit along south wall in SE quad	[0.80][b]
WP1005 (V-35)	2nd floor: inside of perimeter HVAC unit along south wall in SE quad	5.2[a]
WP1006 (V-34)	2nd floor: inside of perimeter HVAC unit along south wall in SE quad	13.6
WP1007 (R-201)	2nd floor: column in SE quad	[1.6]
WP1008 (R-224)	2nd floor: column in SE quad	[1.6]
WP1009 (V-33)	2nd floor: inside of perimeter HVAC unit along south wall in SE quad	[2.6][a]
WP1010 (R-225)	2nd floor: ceiling beam ledge in SE quad	ND[c]
WP1011 (E-42)	2nd floor: wall between elevator lobby and and fire exit in SE quad	[1.6]
WP1012	Field blank	ND
WP1013 (R-222)	2nd floor: wall in east stairway in SE quad	16.4[a]
WP1014 (V-31)	2nd floor: inside of HVAC duct in SE quad	8.4
WP1015 (E-32)	2nd floor: column in SW quad	[0.80]
WP1016 (R-228)	2nd floor: floor in SW quad	5.6
WP1017 (R-210)	2nd floor: floor in SW quad	3.0
WP1018 (E-44)	2nd floor: column in SW quad	ND
WP1019 (R-211)	2nd floor: ceiling beam ledge in SW quad	ND
WP1020 (R-206)	2nd floor: floor in SW quad	7.2
WP1021 (R-217)	2nd floor: floor in NW quad	[2.5]
WP1022 (R-218)	2nd floor: floor in NW quad	[2.8]
WP1023 (R-220)	2nd floor: window along west in NW quad	ND
WP1024	Field blank	ND
WP1025 (R-231)	2nd floor: floor in NW quad	3.4
WP1026 (R-216)	2nd floor: floor in NW quad	3.6
WP1027 (R-214)	2nd floor: wall in NW quad	[0.76]
WP1028 (R-230)	2nd floor: wall in utility closet	[0.44]
WP1029 (R-232)	2nd floor: floor in stairwell	3.3[a]
WP1030 (R-204)	2nd floor: column in NW quad	[0.64]
WP1031 (V-39)	2nd floor: inside of HVAC duct in NW quad	5.2[a]
WP1032 (R-202)	2nd floor: wall in NE quad	[0.70]
WP1033 (R-233)	2nd floor: ceiling in NE quad	ND
WP1034 (R-215)	2nd floor: ceiling beam ledge in NE quad	ND
WP1035 (R-226)	2nd floor: floor in NE quad	5.6

Table 1 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP1036	Field blank	ND
WP1037 (R-221)	2nd floor: ceiling beam ledge in NE quad	ND
WP1038 (R-223)	2nd floor: ceiling in NE quad	ND
WP1039 (E-37)	2nd floor: column in NE quad	3.7
WP1040 (R-219)	2nd floor: wall in NE quad	ND
WP1041 (R-213)	2nd floor: wall in NE quad	5.6
WP1042 (E-38)	2nd floor: floor in mens restroom in NE quad	6.8[a]
WP1043 (R-208)	2nd floor: floor in elevator lobby	3.9[a]
WP1044 (E-40)	2nd floor: door of elevator	3.9[a]
WP1045 (E-43)	2nd floor: wall in west mechanical room	8.0[a]
WP1046 (V-1)	2nd floor: west HVAC unit air intake plenum	[1.1][a]
WP1047 (V-2)	2nd floor: west HVAC unit supply air duct	ND
WP1048	Field blank	ND
WP1049 (R-209)	2nd floor: wall in west mechanical room	[1.1]
WP1050 (V-3)	2nd floor: east HVAC air intake plenum	6.0[a]
WP1051 (V-4)	2nd floor: east HVAC supply air duct	[2.4][a]
WP1052 (R-227)	2nd floor: wall and lightswitch in east restroom	6.4
WP1053 (R-229)	2nd floor: door in east mechanical room	[1.2]
WP1054 (R-212)	2nd floor: side of east HVAC unit	[1.8]
WP1055 (R-203)	2nd floor: wall womens restroom	ND
WP1056 (E-24)	3rd floor: column in SE quad	[0.40]
WP1057 (V-23)	3rd floor: inside of perimeter HVAC unit along south wall in SE quad	4.4
WP1058 (E-22)	3rd floor: top of HVAC duct in SE quad	2.8
WP1059 (R-316)	3rd floor: wall in SE quad	ND
WP1060	Field blank	ND
WP1061 (R-305)	3rd floor: column in SE quad	ND
WP1062 (V-19)	3rd floor: inside of perimeter HVAC unit along south wall in SE quad	3.5
WP1063 (R-310)	3rd floor: floor in SE quad	[2.2]
WP1064 (R-318)	3rd floor: ceiling beam ledge in SE quad	ND
WP1065 (R-308)	3rd floor: wall in SE quad	ND
WP1066 (R-306)	3rd floor: column in SE quad	[0.40]
WP1067 (V-20)	3rd floor: inside of perimeter HVAC unit along south wall in SW quad	ND
WP1068 (R-315)	3rd floor: ceiling beam ledge in SW quad	ND
WP1069 (R-309)	3rd floor: floor in SW quad	ND
WP1070 (R-312)	3rd floor: column in SW quad	ND
WP1071 (V-18)	3rd floor: inside of perimeter HVAC unit along south wall in SW quad	4.8
WP1072	Field blank	ND
WP1073 (R-321)	3rd floor: floor in SW quad	3.6

Table 1 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP1074 (E-21)	3rd floor: top of vent duct Sw quad	ND
WP1075 (R-304)	3rd floor: floor in SW quad	4.4[d]
WP1076 (R-303)	3rd floor: ceiling in SW quad	ND
WP1077 (R-302)	3rd floor: floor in SW quad	6.4[e]
WP1078 (E-30)	3rd floor: column in SW quad	ND
WP1079 (V-29)	3rd floor: inside of perimeter HVAC unit along west wall in SW quad	ND
WP1080 (R-323)	3rd floor: floor in NW quad	11.3[e]
WP1081 (R-327)	3rd floor: floor in NW quad	[1.2][e]
WP1082 (R-324)	3rd floor: wall west mechanical room in NW quad	ND
WP1083 (R-330)	3rd floor: wall west men's restroom	ND
WP1084	Field blank	ND
WP1085 (E-28)	3rd floor: floor west men's restroom	[1.5]
WP1086 (R-307)	3rd floor: wall telephone room	ND
WP1087 (R-319)	3rd floor: wall stairway	ND
WP1088 (R-313)	3rd floor: ceiling beam ledge SW quad	ND
WP1089 (R-325)	3rd floor: ceiling beam ledge NE quad	ND
WP1090 (R-301)	3rd floor: floor in NE quad	ND
WP1091 (R-326)	3rd floor: ceiling NE quad	ND
WP1092 (R-322)	3rd floor: wall in NE quad	ND
WP1093 (R-314)	3rd floor: floor in NE quad	11.2[e]
WP1094 (R-328)	3rd floor: floor in NE quad	5.6[e]
WP1095 (E-26)	3rd floor: floor men's restroom	ND
WP1096	Field blank	ND
WP1097 (R-311)	3rd floor: door of janitors closet	ND
WP1098 (E-25)	3rd floor: wall east mechanical room	[0.48]
WP1099 (V-5)	3rd floor: east HVAC air intake plenum	[1.5]
WP1100 (V-6)	3rd floor: east AHU supply air duct	6.4
WP1101 (V-7)	3rd floor: inside of vent duct in NE quad	5.2[a]
WP1102 (V-8)	3rd floor: inside of vent duct in NE quad	ND
WP1103 (V-9)	3rd floor: inside of vent duct in NE quad	8.8
WP1104 (V-10)	3rd floor: inside of vent duct in NW quad	ND
WP1105 (V-11)	3rd floor: west AHU air intake plenum	[1.1]
WP1106 (V-12)	3rd floor: west AHU supply air duct	ND
WP1107 (V-13)	3rd floor: inside of vent duct in SW quad	[2.7]
WP1108	Field blank	ND
WP1109 (V-14)	3rd floor: inside of vent duct in SW quad	[1.3]
WP1110 (R-329)	3rd floor: floor in elevator lobby	[1.6]
WP1111 (E-27)	3rd floor: elevator door	[0.80]
WP1112 (R-404)	4th floor: floor SE quad	21.5[e]
WP1113 (R-427)	4th floor: floor SE quad	ND
WP1114 (E-6)	4th floor: column in SE quad	ND

Table 1 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP1115 (V-5)	4th floor: inside of perimeter HVAC unit along east wall in SE quad	ND
WP1116 (R-403)	4th floor: floor in SE quad	[0.92]
WP1117 (R-411)	4th floor: wall in SE quad	ND
WP1118 (E-4)	4th floor: column in SE quad	ND
WP1119 (V-3)	4th floor: inside of perimeter HVAC unit along south wall in SE quad	[0.40]
WP1120	Field blank	ND
WP1121 (E-2)	4th floor: column in SE quad	ND
WP1122 (V-1)	4th floor: inside of perimeter HVAC unit along south wall in SE quad	[1.1]
WP1123 (R-428)	4th floor: ceiling beam ledge in SE quad	ND
WP1124 (E-7)	4th floor: top of vent duct in SE quad	ND
WP1125 (E-9)	4th floor: wall in SE quad	[0.36]
WP1126 (R-410)	4th floor: floor in SE quad	[1.6]
WP1127 (R-424)	4th floor: floor in SE quad	11.0
WP1128 (E-8)	4th floor: elevator door	[1.2][a]
WP1129 (R-412)	4th floor: wall in SW quad	[0.88]
WP1130 (R-402)	4th floor: beam ledge in SW quad	ND
WP1131 (R-413)	4th floor: ceiling in SW quad	ND
WP1132	Field blank	ND
WP1133 (E-15)	4th floor: wall in SW quad	ND
WP1134 (V-14)	4th floor: inside of perimeter HVAC unit along south wall in SW quad	[0.56]
WP1135 (R-407)	4th floor: floor in SW quad	[1.40]
WP1136 (R-409)	4th floor: column in SW quad	ND
WP1137 (E-16)	4th floor: top of vent duct in SW quad	ND
WP1138 (R-406)	4th floor: floor in NW quad	[1.04]
WP1139 (R-429)	4th floor: beam ledge in NW quad	ND
WP1140 (R-426)	4th floor: outside of perimeter HVAC unit along north in NW quad	ND
WP1141 (E-12)	4th floor: column in NW quad	ND
WP1142 (V-11)	4th floor: inside of perimeter HVAC unit along north wall in NW quad	6.4[d]
WP1143 (R-423)	4th floor: floor in NW quad	8.1[e]
WP1144	Field blank	ND
WP1145 (R-418)	4th floor: wall in NW quad	[1.0]
WP1146 (E-13)	4th floor: floor in west men's restroom	ND
WP1147 (R-405)	4th floor: wall in telephone room	ND
WP1148 (R-420)	4th floor: floor in NW quad	2.9[a]
WP1149 (R-414)	4th floor: outside of perimeter HVAC unit along north in NE quad	ND
WP1150 (E-17)	4th floor: top of vent duct in NE quad	ND

Table 1 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP1151 (R-430)	4th floor: floor in NE quad	[1.1][a]
WP1152 (R-402)	4th floor: beam ledge in NE quad	[1.9][d]
WP1153 (R-408)	4th floor: floor in NE quad	[1.2][a]
WP1154 (R-422)	4th floor: wall in NE quad	[1.2]
WP1155 (E-10)	4th floor: east mechanical room wall	9.6[a]
WP1156	Field blank	ND
WP1157 (R-425)	4th floor: east mechanical room ceiling	[1.9]
WP1158 (R-419)	4th floor: east mechanical room wall	[1.6][a]
WP1159 (V-15)	4th floor: east HVAC unit air intake plenum	[1.6][a]
WP1160 (V-16)	4th floor: east HVAC unit supply air duct	[1.6][a]
WP1161 (V-17)	4th floor: inside of vent duct in SE quad	ND
WP1162 (V-18)	4th floor: inside of vent duct in SE quad	[0.88]
WP1163 (V-19)	4th floor: inside of vent duct in NE quad	3.2[a]
WP1164 (V-20)	4th floor: inside of vent duct in NE quad	ND
WP1165 (R-417)	4th floor: door in west men's restroom	ND
WP1166 (R-416)	4th floor: outside of HVAC unit along W wall	ND
WP1167 (V-21)	4th floor: west HVAC unit air intake plenum	ND
WP1168	Field blank	ND
WP1169 (V-22)	4th floor: west HVAC unit supply air duct	[0.44]
WP1170 (V-23)	4th floor: inside of vent duct in SW quad	ND
WP1171 (V-24)	4th floor: inside of vent duct in SW quad	[2.5]
WP1172 (E-49)	Lobby: outside face of elevator door	3.2
WP1173 (E-47)	Lobby: south interior wall in room 1-N	5.6[a]
WP1174 (E-45)	Lobby: floor in room 1-N	15.6[a]
WP1175 (E-44)	Lobby: window ledge in room 1-N	9.2[a]
WP1176 (R-124)	Lobby: wall in room 1-R	[1.6][a]
WP1177 (R-114)	Lobby: wall in room 1-R	ND
WP1178 (R-132)	Lobby: wall in room 1-R	[1.3]
WP1179 (R-149)	Lobby: floor in room 1-N	8.8
WP1180	Field blank	ND
WP1181 (R-154)	Lobby: wall in room 1-N	ND
WP1182 (R-105)	Lobby: floor in room 1-N	13.2
WP1183 (R-143)	Lobby: wall in room 1-N	4.4[a]
WP1184 (R-137)	Lobby: wall in room 1-M	[2.5]
WP1185 (E-51)	Lobby: door of elevator	4.4
WP1186 (E-46)	Lobby: wall in stairwell room 1-O	4.4
WP1187 (E-48)	Lobby: wall in room 1-N	4.4
WP1188 (R-147)	Mezzanine: ceiling in room 1-P	[2.2]
WP1189 (R-136)	Mezzanine: ceiling in room 1-P	[1.3]
WP1190 (R-145)	Lobby: wall in room 1-N	[1.9][a]
WP1191 (E-55)	Lobby: floor in room 1-N	24.0[a]
WP1192	Field blank	ND
WP1193 (E-56)	Lobby: window ledge in room 1-N	10.0[a]

Table 1 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP1194 (R-133)	1st floor: floor in room 1-K	[0.88][a]
WP1195 (R-155)	1st floor: wall in room 1-K	ND
WP1196 (R-158)	1st floor: wall in room 1-K	[0.68]
WP1197 (R-116)	1st floor: table in room 1-K	[0.92]
WP1198 (R-104)	1st floor: table in room 1-K	[1.3]
WP1199 (E-53)	1st floor: table in room 1-F	7.2
WP1200 (R-130)	1st floor: wall in room 1-F	[2.6]
WP1201 (R-160)	1st floor: wall in room 1-D	[0.80]
WP1202 (R-126)	1st floor: floor in room 1-D	[1.6]
WP1203 (R-135)	1st floor: women's restroom in room 1-I	[2.2]
WP1204	Field blank	ND
WP1205 (R-121)	1st floor: wall in room 1-D	[1.7]
WP1206 (R-129)	1st floor: door in room 1-D	ND
WP1207 (R-152)	1st floor: floor in room 1-D	[1.1][a]
WP1208 (R-103)	1st floor: wall in room 1-D	[2.6]
WP1209 (R-113)	1st floor: floor in room 1-A	5.2[a]
WP1210 (R-112)	1st floor: wall in room 1-A	[0.76]
WP1211 (R-123)	1st floor: wall in room 1-A	[1.8]
WP1212 (R-120)	1st floor: wall in room 1-A	[1.4]
WP1213 (R-144)	1st floor: wall in room 1-A	[2.5]
WP1214 (R-146)	1st floor: wall in room 1-A	[1.7]
WP1215 (R-151)	1st floor: wall in room 1-A	[2.6]
WP1216	Field blank	ND
WP1217 (R-156)	1st floor: wall in room 1-A	[1.1]
WP1218 (R-148)	1st floor: floor in room 1-A	[2.6]
WP1219 (R-142)	1st floor: desk in room 1-A	[0.84]
WP1220 (R-127)	1st floor: desk in room 1-A	[0.96]
WP1221 (R-140)	1st floor: desk in room 1-A	[2.0]
WP1222 (R-109)	1st floor: face of HEPA air filter unit in room 1-A	ND
WP1223 (R-119)	1st floor: face of computer rack in room 1-A	ND
WP1224 (R-111)	1st floor: ceiling in room 1-B	ND
WP1225 (R-108)	1st floor: wall in room 1-B	[0.76]
WP1226 (R-125)	1st floor: wall in room 1-B	ND
WP1227 (R-107)	1st floor: ceiling in NE quad	[1.3]
WP1228	Field blank	ND
WP1229 (R-141)	1st floor: wall in room 1-C	[1.7][a]
WP1230 (R-150)	1st floor: wall in room 1-C	[1.8][a]
WP1231 (R-118)	1st floor: desk in room 1-C	[0.72]
WP1232 (R-131)	1st floor: wall in room 1-G	[1.5]
WP1233 (R-139)	1st floor: top of file cabinet in room 1-G	[0.76]
WP1234 (R-101)	1st floor: desk in room 1-F	8.6[e]
WP1235 (R-157)	1st floor: wall in room 1-F	[0.68]

Table 1 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP1236 (R-159)	1st floor: wall in room 1-F	[2.1]
WP1237 (R-117)	1st floor: wall in room 1-F	[2.2]
WP1238 (R-122)	1st floor: wall in room 1-F	3.3
WP1239 (R-110)	1st floor: floor in room 1-F	ND
WP1240	Field blank	ND
WP1241 (E-54)	1st floor: desk in room 1-F	ND
WP1242 (R-128)	1st floor: wall in Room 1-F	[1.1]
WP1243 (R-102)	1st floor: floor in room 1-F	ND
WP1244 (R-153)	1st floor: floor in room 1-J	[0.52]
WP1245 (R-138)	1st floor: wall in room 1-J	ND
WP1246 (R-115)	1st floor: wall in room 1-J	ND
WP1247 (R-134)	1st floor: desk in room 1-J	[2.0]
WP1248 (V-25)	1st floor: inside vent duct in room 1-F	8.4
WP1249 (V-26)	1st floor: inside vent duct in room 1-F	13.2
WP1250 (V-27)	1st floor: inside vent duct in room 1-C	[1.8]
WP1251 (V-28)	1st floor: inside vent duct in room 1-C	[1.3]
WP1252	Field blank	ND
WP1253 (E-52)	1st floor: wall in room 1-L	ND
WP1254 (V-50B)	Lobby: outside fresh air intake louvers above south entrance	34.0

[a]Denotes that the sample contained a mixture of Aroclors 1254 and 1260.
[b]The value in brackets denotes that the stated PCB concentration is between the limit of detection (see footnote "c") and limit of quantitation. The limit of quantitation is 2.7 ug/m^2 for Aroclor 1242, and 2.8 ug/m^2 for Aroclors 1254 and 1260.

[c]ND denotes none-detected. The limit of detection is 0.36 ug/m^2 for Aroclors 1242, 1254, and 1260.
[d]Denotes that the sample contained Aroclor 1242.
[e]Denotes that the sample contained a mixture of Aroclors 1242 and 1260.

Table 2

Surface Concentrations of Polychlorinated Biphenyls

50 Staniford Office Building , Boston, Massachusetts, January 22 - 23, 1987

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP2001 (R-139)	Upper garage: wall in room 1	ND[a]
WP2002 (R-131)	Upper garage: wall in room 1	[0.20][b]
WP2003 (R-164)	Upper garage: ceiling in room 1	0.64
WP2004 (R-187)	Upper garage: ceiling in room 1	1.2
WP2005 (R-172)	Upper garage: wall in room 2	0.72
WP2006 (R-134)	Upper garage: ceiling in room 2	1.4
WP2007 (R-143)	Upper garage: wall in room 2	0.84
WP2008 (R-176)	Upper garage: wall in room 2	1.0
WP2009 (R-152)	Upper garage: wall in room 3	2.6
WP2010 (R-110)	Upper garage: floor in room 3	5.2
WP2011 (R-161)	Upper garage: wall in room 3	2.8
WP2012	Field blank	ND
WP2013 (R-101)	Upper garage: wall in room 4	[0.16]
WP2014 (R-167)	Upper garage: wall in room 4	ND
WP2015 (R-122)	Upper garage: wall in room 4	[0.28]
WP2016 (R-145)	Upper garage: wall in room 4	1.2
WP2017 (R-150)	Upper garage: wall in room 4	1.2
WP2018 (R-178)	Upper garage: wall in room 4	1.2
WP2019 (R-174)	Upper garage: wall in room 4	3.1
WP2020 (R-114)	Upper garage: wall in room 4	3.6
WP2021 (R-141)	Upper garage: ceiling in room 4	48.0
WP2022 (R-117)	Upper garage: floor in room 5	[0.12]
WP2023 (R-147)	Upper garage: ceiling in room 5	ND
WP2024	Field blank	ND
WP2025 (E-1)	Upper garage: wall in room 5	[0.20]
WP2026 (R-103)	Upper garage: ceiling in room 6	ND
WP2027 (R-180)	Upper garage: wall in room 7	1.1
WP2028 (R-107)	Upper garage: wall in room 7	1.4
WP2029 (R-140)	Upper garage: wall in room 7	1.3
WP2030 (R-115)	Upper garage: wall in room 7	1.7
WP2031 (R-173)	Upper garage: wall in room 7	1.3
WP2032 (R-171)	Upper garage: ceiling in room 7	3.4
WP2033 (R-153)	Upper garage: floor in room 8	ND
WP2034 (R-118)	Upper garage: floor in room 8	ND
WP2035 (R-154)	Upper garage: wall in room 8	0.52
WP2036	Field blank	ND
WP2037 (R-162)	Upper garage: wall in room 8	0.80
WP2038 (R-155)	Upper garage: wall in room 10	1.5
WP2039 (R-119)	Upper garage: wall in room 10	0.76
WP2040 (R-190)	Upper garage: floor in room 10	ND
WP2041 (R-129)	Upper garage: wall in room 10	0.48
WP2042 (R-149)	Upper garage: wall in room 10	[0.24]

Table 2 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP2045 (R-137)	Upper garage: wall in room 11	0.56
WP2043 (R-142)	Upper garage: wall in room 10	0.56
WP2044 (R-184)	Upper garage: wall in room 11	0.44
WP2046 (R-121)	Upper garage: wall in room 11	[0.16]
WP2047 (R-111)	Upper garage: wall in room 11	0.44
WP2048	Field blank	ND
WP2049 (R-193)	Upper garage: light switch in room 11	1.8
WP2050 (R-144)	Upper garage: wall in room 11	1.3
WP2051 (R-181)	Upper garage: floor in room 11	ND
WP2052 (R-182)	Upper garage: ceiling in room 11	ND
WP2053 (R-135)	Upper garage: wall in room 12	1.6
WP2054 (R-104)	Upper garage: wall in room 12	0.84
WP2055 (R-106)	Upper garage: wall in room 12	1.6
WP2056 (R-130)	Upper garage: floor in room 12	3.2
WP2057 (R-112)	Upper garage: wall in room 12	0.68
WP2058 (R-165)	Upper garage: floor in room 12	1.4
WP2059 (R-170)	Upper garage: door in room 14	ND
WP2060	Field blank	ND
WP2061 (R-123)	Upper garage: light switch in room 15	[0.76]
WP2062 (R-102)	Upper garage: floor in room 17	1.1
WP2063 (R-133)	Upper garage: door in room 17	1.2
WP2064 (R-146)	Upper garage: wall in room 17	[0.72]
WP2065 (R-175)	Upper garage: wall in room 17	1.7
WP2066 (R-138)	Upper garage: wall in room 17	1.4
WP2067 (R-163)	Upper garage: floor in room 17	[0.72]
WP2068 (R-127)	Upper garage: wall in room 18	1.6
WP2069 (R-160)	Upper garage: wall in room 18	[0.48]
WP2070 (R-188)	Upper garage: wall in room 18	[0.40]
WP2071 (R-179)	Upper garage: ceiling in room 18	ND
WP2072	Field blank	ND
WP2073 (R-177)	Upper garage: ceiling in room 18	ND
WP2074 (R-159)	Upper garage: ceiling in room 18	ND
WP2075 (R-124)	Upper garage: floor in room 20	[0.32]
WP2076 (R-126)	Upper garage: wall in rooom 20	[0.32]
WP2077 (R-113)	Upper garage: door in room 20	[0.48]
WP2078 (R-183)	Upper garage: door in room 20	[0.68]
WP2079 (R-168)	Upper garage: wall in room 20	1.3
WP2080 (R-148)	Upper garage: wall in room 20	0.92
WP2081 (R-132)	Upper garage: wall in room 20	0.82
WP2082 (R-128)	Upper garage: floor in room 20	[0.44]
WP2083 (R-166)	Upper garage: wall in room 20	1.2
WP2084	Field blank	ND
WP2085 (R-151)	Upper garage: wall in room 20	1.4
WP2086 (R-116)	Upper garage: wall in room 20	[0.48]
WP2087 (R-185)	Upper garage: wall in room 21	0.88
WP2088 (R-169)	Upper garage: wall in room 21	1.04

Table 2 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP2089 (R-120)	Upper garage: wall in room 21	1.7
WP2090 (R-109)	Upper garage: wall in room 21	1.3
WP2091 (R-189)	Upper garage: wall in room 21	[0.61]
WP2092 (R-191)	Upper garage: wall in room 21	1.2
WP2093 (R-186)	Upper garage: wall in room 21	[0.52]
WP2094 (R-157)	Upper garage: wall in room 21	[0.52]
WP2095 (R-136)	Upper garage: wall in room 21	[0.52]
WP2096	Field blank	ND
WP2097 (R-125)	Upper garage: wall in room 21	[0.52]
WP2098 (R-105)	Upper garage: wall in room 21	[0.48]
WP2099 (R-156)	Upper garage: wall in room 21	[0.48]
WP2100 (R-192)	Upper garage: wall in room 21	[0.40]
WP2101 (E-2)	Upper garage: floor in room 21	ND
WP2102 (R-108)	Upper garage: wall in room 108	[0.32]
WP2103 (R-158)	Upper garage: ceiling in room 21	1.7
WP2104 (V-3)	Upper garage: vent duct in room 11	2.5
WP2105 (V-4)	Upper garage: vent duct in room 10	8.0
WP2106 (V-5)	Upper garage: vent duct in room 5	1.8
WP2107 (V-6)	Upper garage: vent duct in room 18	3.2
WP2108	Field blank	ND
WP2109 (E-7)	Upper garage: floor in room 7	ND
WP2110 (V-8)	Upper garage: vent duct in room 17	3.8
WP2111 (V-9)	Upper garage: vent duct in room 17	[0.48]
WP2112 (E-10)	Upper garage: floor in room 19	ND
WP2113 (E-11)	Upper garage: wall in room 6	[0.92]
WP2114 (E-12)	Upper garage: wall in room 9	[0.44]
WP2115 (E-13)	Lobby: window ledge along south wall	21.0
WP2116 (E-14)	Lobby: floor in SW quad	1.1
WP2117 (E-15)	Lobby: panneled wall along south side	ND
WP2118 (E-16)	Lobby: floor in NE quad	[0.72]
WP2119 (E-17)	Lobby: guards table in NW quad	2.5
WP2120 (E-18)	Lobby: wall in NW quad	ND
WP2121	Field blank	ND
WP2122 (E-19)	Lobby: floor in room 1-P	8.4
WP2123 (E-20)	Lobby: wall in room 1-P	[1.5]
WP2124 (E-21)	Lobby: wall in garage elevator	[2.1]
WP2125 (E-22)	Lobby: wall in passenger elevator	9.6
WP2126 (E-23)	Lobby: wall at west elevator bank	[1.3]
WP2127 (E-24)	Lobby: wall in west elevator bank	4.8
WP2128 (E-25)	Lobby: floor in room 1-O	34.0
WP2129 (E-26)	Lobby: wall in room 1-O	7.2
WP2130 (V-27)	Lobby: air intake louver at SW entrance	3.4
WP2131 (E-28)	1st floor: wall in room 1-K	ND
WP2132	Field blank	ND
WP2133 (E-29)	1st floor: wall in room 1-F	ND

Table 2 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP2134 (E-30)	1st floor: door in room 1-F	ND
WP2135 (E-31)	1st floor: wall in room 1-F	ND
WP2136 (E-32)	1st floor: wall in room 1-C	ND
WP2137 (E-33)	1st floor: floor in room 1-C	2.9
WP2138 (E-34)	1st floor: door in room 1-C	ND
WP2139 (E-72)	1st floor: wall in room 1-D	ND
WP2140 (E-35)	1st floor: wall in room 1-D	ND
WP2141 (E-36)	1st floor: floor in room 1-I	6.8
WP2142 (E-37)	1st floor: floor in room 1-A	ND
WP2143 (E-38)	1st floor: wall in room 1-A	ND
WP2144	Field blank	ND
WP2145 (E-39)	1st floor: floor in room 1-B	ND
WP2146 (E-40)	1st floor: wall in room 1-B	ND
WP2147 (E-41)	1st floor: desk in room 1-A	ND
WP2148 (E-42)	1st floor: desk in room 1-A	ND
WP2149 (E-43)	1st floor: door in room 1-A	ND
WP2150 (E-44)	1st floor: desk in room 1-A	ND
WP2151 (E-45)	1st floor: desk in room 1-B	[0.76]
WP2152 (E-46)	1st floor: door in room 1-B	[0.88]
WP2153 (E-47)	1st floor: desk in room 1-D	[0.76]
WP2154 (E-48)	1st floor: book shelf in room 1-C	ND
WP2155 (E-49)	1st floor: table in room 1-C	[0.72]
WP2156	Field blank	ND
WP2157 (E-50)	1st floor: table in room 1-C	[0.80]
WP2158 (E-51)	1st floor: table in room 1-K	ND
WP2159 (E-52)	1st floor: table in room 1-K	ND
WP2160 (E-53)	1st floor: desk in room 1-K	ND
WP2161 (E-54)	1st floor: desk in room 1-K	[0.80]
WP2162 (E-55)	1st floor: desk in room 1-K	ND
WP2163 (E-56)	1st floor: desk in room 1-K	ND
WP2164 (E-57)	1st floor: table in room 1-G	[0.84]
WP2165 (E-58)	1st floor: file cabinet in room 1-G	ND
WP2166 (E-59)	1st floor: cabinet in 1-G	ND
WP2167 (E-60)	1st floor: desk in room 1-F	3.6
WP2168	Field blank	ND
WP2169 (E-61)	1st floor: desk in room 1-K	[0.56]
WP2170 (E-62)	1st floor: cabinet in room 1-K	ND
WP2171 (E-63)	1st floor: table in room 1-F	[0.69]
WP2172 (V-64)	1st floor: vent duct in room 1-C	16.0
WP2173 (V-65)	1st floor: vent duct in room 1-F	11.0
WP2174 (V-66)	1st floor: vent duct in room 1-C	14.0
WP2175 (V-67)	1st floor: vent duct in room 1-C	7.6
WP2176 (V-68)	1st floor: vent duct in room 1-A	[1.2]
WP2177 (V-69)	1st floor: vent duct in room 1-A	6.8

Table 2 Continued

Sample Number	Sample Location	Aroclor 1254 ug/m^2
WP2178 (E-70)	1st floor: floor in room 1-L	14
WP2179 (E-71)	1st floor: wall in room 1-L	ND
WP2180	field blank	ND

[a]ND denotes none-detected. The limit of detection is 0.12 ug/m^2 for sample numbers WP2001 - WP2060, 0.36 ug/m^2 for sample numbers WP2061 - WP2120, and 0.48 ug/m^2 for sample numbers WP2121 - WP2180.

[b]The value in brackets denotes that the stated concentration is between the limit of detection and the limit of quantitation. The limit of quantitation is 0.36 ug/m^2 for sample numbers WP2001 - WP2060, 0.76 ug/m^2 for sample numbers WP2061 - WP2120, and 2.12 ug/m^2 for sample numbers WP2121 - WP2180.

Table 3
Summary of Polychlorinated Biphenyl (PCBs) Concentrations
on Building Surfaces
50 Staniford Street Office Building
Boston, Massachusetts
February 21 - 23, 1986 and January 22 - 23, 1987

			Surface Concentration ug/m^2			
Date	Strata	n/N[a]	Range[b]	Mean	95% Confidence Interval for Mean	Std. Dev.
WEIGHTED RANDOM SAMPLES:						
2/86	Floors 2 - 4	51/89	(0.36) - 22	2.2	1.4 - 3.0	3.7
2/86	Lobby & Floor 1	47/60	(0.36) - 13	1.8	1.2 - 2.4	2.2
1/87	Upper Basement[c]	80/93	(0.12) - 48	1.5	0.4 - 2.5	4.9
BEST ENGINEERING JUDGEMENT SAMPLES:						
2/86	Floors 2 - 4	16/28	(0.36) - 8.0	1.9	0.9 - 2.9	2.7
2/86	Lobby & Floor 1	2/12	(0.36) - 16	7.4	3.1 - 12	6.8
1/87	Lobby & Floor 1	25/51	(0.12) - 34	2.5	0.9 - 4.1	5.8
1/87	Upper Basement	3/6	(0.12) - 0.9	0.4	-	0.3

[a]n/N is the number of samples with comcentrations above the detection limit/ total number of samples collected.

[b]The detection limit is in parentheses.

Table 4

Summary of Polychlorinated Biphenyl (PCBs) Concentrations
on Heating, Ventilation, and Air-Conditioning (HVAC) System Surfaces

50 Staniford Street Office Building
Boston, Massachusetts

February 21 - 23, 1986 and January 22 - 23, 1987

			Surface Concentration ug/m^2			
Date	Strata	n/N[a]	Range[b]	Mean	95% Confidence Interval for Mean	Std. Dev.
2/86	Floors 2 - 4	28/39	(0.36) - 14	2.7	1.7 - 3.7	3.1
2/86	Lobby & Floor 1	6/6	1.3 - 88	25	-10 - 59	33
1/87	Lobby & Floor 1	7/7	1.2 - 16	8.5	3.5 - 14	5.4
1/87	Upper Basement	6/6	0.48 - 8	3.3	0.6 - 6	2.6

[a]n/N is the number of samples with concentrations above the detection limit/total number of samples collected.

[b]The detection limit is in parentheses.

Table 5

Surface Concentrations of Polychlorinated Dibenzofurans (PCDFs)
and Polychlorinated Dibenzo-p-Dioxins (PCDDs)

50 Staniford Street Office Building
Boston, Massachusetts

February 21 - 23, 1986

Sample No	Sample Location	Surface Concentration ng/m^2					
		Tetra CDF	2378 Tetra CDFs	Total Penta CDFs	Total Hexa CDFs	Total Hepta CDFs	Total Octa CDF
503	Floor 4 wall	(0.16)[a]	0.20	(0.013)	(0.009)	(0.11)	(0.29)
502	Floor 3 wall	0.47	1.4	0.16	0.053	0.036	0.085
501	Floor 2 wall	0.78	2.6	0.51	0.15	0.032	0.084
504	Lobby wall	8.9	28	2.8	0.72	0.72	2.1
505	Flr 1 table rm 1K	0.88	1.9	0.43	0.27	0.16	0.34
506	Field blank	(0.022)	(0.022)	(0.012)	(0.007)	(0.039)	(0.060)
		2378 Tetra CDD	Total Tetra CDDs	Total Penta CDDs	Total Hexa CDDs	Total Hepta CDDs	Octa CDD
503	Floor 4 wall	(0.054)	(0.054)	(0.033)	(0.019)	(0.013)	1.5
502	Floor 3 wall	(0.031)	(0.031)	(0.022)	(0.015)	0.097	1.1
501	Floor 2 wall	(0.050)	(0.050)	(0.019)	(0.030)	0.17	1.9
504	Lobby wall	(0.075)	(0.075)	(0.076)	(0.048)	0.89	2.9
505	Flr 1 table r1K	(0.063)	(0.063)	(0.034)	(0.015)	0.54	6.2
506	Field blank	(0.047)	(0.047)	(0.027)	(0.016)	0.034	0.68

[a]The parentheses denotes none-detected. The value in parentheses is the limit of detection.

Table 6

Surface Concentrations of Polychlorinated Dibenzofurans (PCDFs)
and Polychlorinated Dibenzo-p-Dioxins (PCDDs)

50 Staniford Street Office Building
Boston, Massachusetts

January 22 - 23, 1987

Sample No.	Sample Location	Surface Concentration ng/m^2					
		2378 Tetra CDF	Total Tetra CDFs	Total Penta CDFs	Total Hexa CDFs	Total Hepta CDFs	Octa CDF
517	Floor 1 desk rm 1A	0.16	0.34	0.054	(0.015)	(0.022)	(0.055)
518	Floor 1 table rm 1K	0.301	1.28	0.16	(0.020)	(0.066)	0.079
	UPPER GARAGE:						
511	Room 3: floor	11.7	49.1	14.8	4.15	1.7	0.704
512	Room 5: wall	0.13	0.39	0.109	(0.030)	(0.075)	(0.370)
513	Room 11: wall	0.38	2.08	0.29	0.040	(0.012)	0.047
514	Room 21: floor	(0.033)	(0.033)	(0.019)	(0.012)	(0.011)	0.029
516	Room 11: vent duct	2.03	7.56	3.85	0.95	0.33	0.302
515	Field blank	(0.028)	(0.028)	(0.007)	(0.005)	(0.012)	(0.018)

		2378 Tetra CDF	Total Tetra CDFs	Total Penta CDFs	Total Hexa CDFs	Total Hepta CDFs	Octa CDF
517	Floor 1 desk rm 1A	(0.074)	(0.074)	(0.018)	(0.026)	0.11	0.43
518	Floor 1 table rm1K	(0.011)	(0.011)	(0.054)	(0.044)	0.096	0.57
	UPPER GARAGE:						
511	Room 3: floor	(0.12)	0.089	(0.014)	(0.010)	0.39	0.89
512	Room 5: wall	(0.26)	(0.26)	(0.105)	(0.053)	(0.095)	0.18
513	Room 11: wall	(0.063)	(0.063)	(0.015)	(0.013)	0.030	0.16
514	Room 21 floor	(0.042)	(0.042)	(0.021)	(0.015)	0.043	0.12
516	Room 11: vent duct	(0.181)	(0.181)	(0.024)	(0.022)	0.22	0.66
515	Field blank	(0.045)	(0.045)	(0.009)	(0.015)	(0.016)	0.015

[a]The parentheses denotes none-detected. The value in parentheses is the limit of detection.

Table 7

Surface Concentrations of
2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) Equivalents

50 Staniford Street Office Building
Boston, Massachusetts

February 21 - 23, 1986 and January 22 - 23, 1987

Sample Date	Sample Number	Sample Location	Conc. TCDD Equivalents ng/m^2
2/86	503	4th floor: column SE quad	0[a]
2/86	502	3rd floor: column SE quad	0.06
2/86	501	2nd floor: column SE quad	0.21
2/86	504	Lobby (room 1-N): wall	1.17
2/86	505	1st floor (room 1-F): desk	0.13
2/86	506	Field blank	0
1/87	517	1st floor (room 1-A): desk	0.02
1/87	518	1st floor (room 1-F): table	0.05
1/87	511	Upper garage (room 3): floor	2.69
1/87	512	Upper garage (room 5): ceiling	0.02
1/87	513	Upper garage (room 11): wall	0.07
1/87	514	Upper garage (room 21): floor	0.00004
1/87	516	Upper garage (room 11: vent duct	0.59
1/87	515	Field blank	0

[a]A value of zero resulted because the none-detected values were treated as zero in calculating the concentration of 2,3,7,8-TCDD equivalents.

Table 8

Airborne Concentrations of Polychlorinated Biphenyls (PCBs)

50 Staniford Street Office Building
Boston, Massachusetts

February 21 - 23, 1986

Sample Number	Sample Location	Sample Volume Liters	Total PCB Conc. ug/m^3
606	4th floor: NE quad	3220	0.24
605	4th floor: SW quad	3350	0.21
604	3rd floor: SE quad	4050	0.22
603	3rd floor: NW quad	4000	0.17
601	2nd floor: NE quad	3570	0.22
602	2nd floor: SW quad	3670	0.18
608	Lobby: NE quad	3230	0.15
609	1st floor: SW quad	3160	0.12
610	1st floor: NE quad	3210	0.22
607	Roof: ambient air intake	3330	0.15

QUALITY ASSURANCE SAMPLES:

			Total PCB Conc. ug/sample
611	Field blank	0000	0.24
612	Field blank	0000	0.36
613	Field blank	0000	0.33
001	Lab blank	0000	0.42
002	Lab blank	0000	ND(0.06)[a]

ND denotes none-detected. The limit of detection is in parentheses.

Table 9
Airborne Concentrations of Polychlorinated Biphenyls (PCBs)
50 Staniford Street Office Building
Boston, Massachusetts

January 22 - 23, 1987

Sample Number	Sample Location	Sample Volume Liters	Aroclor Conc. ug/m^3 1242	1254	1260	Total
633	4th floor: SW quad	3181	ND[a]	ND	ND	ND
632	4th floor: NE quad	3187	0.075	0.089	0.093	0.26
630	3rd floor: NE quad	3186	ND	ND	ND	ND
631	3rd floor: SW quad	3060	ND	ND	ND	ND
628	2nd floor: NE quad	3146	ND	ND	ND	ND
629	2nd floor: SW quad	3128	0.45	0.012	ND	0.46
636	Lobby: NE quad	3319	ND	ND	ND	ND
638	1st floor: SW quad	3226	ND	ND	ND	ND
637	1st floor: NW quad	3224	0.15	ND	ND	0.15
621	Upper garage: room 18	3274	ND	ND	ND	ND
627	Upper garage: room 1	3217	ND	ND	ND	ND
625	Upper garage: room 3	3136	0.058	0.027	0.18	0.27
626	Upper garage: room 5	3191	ND	ND	ND	ND
624	Upper garage: room 7	3271	0.017	0.046	0.27	0.33
623	Upper garage: room 11	3214	ND	ND	ND	ND
622	Upper garage: room 21	3130	ND	ND	ND	ND
634	Roof: ambient air intake	3371	ND	ND	0.033	0.033
635	Roof: ambient air intake	3476	0.017	ND	ND	0.017
QUALITY ASSURANCE SAMPLES:		Aroclor Conc. ug/sample				
639	Field blank	0000	ND	ND	ND	ND
640	Field blank	0000	0.059	ND	ND	0.059
641	Field blank	0000	0.051	ND	ND	0.051
642	Field blank	0000	0.017	ND	ND	0.017
001	Lab blank	0000	ND	ND	ND	ND
002	Lab blank	0000	ND	ND	ND	ND
003	Lab blank	0000	ND	ND	ND	ND
004	Lab blank	0000	ND	ND	ND	ND

[a]ND denotes none-detected. The limit of detection is 0.05 ug/sample for each Aroclor.

Table 10

Airborne Concentrations of Polychlorinated Dibenzofurans (PCDFs)
and Polychlorinated Dibenzo-p-Dioxins (PCDDs)

50 Staniford Street Office Building
Boston, Massachusetts

February 21 - 23, 1986

Sample No.	Sample Location	Surface Concentration ng/m^2					
		2378 Tetra CDF	Total Tetra CDFs	Total Penta CDFs	Total Hexa CDFs	Total Hepta CDFs	Octa CDF
803	Floor 4: NE quad	0.48	0.86	(0.13)[a]	(0.13)	(0.31)	(1.3)
802	Floor 3: SE quad	1.2	3.7	(0.14)	(0.14)	(0.86)	1.3
801	Floor 2: SW quad	(0.55)	(0.55)	(0.17)	(0.11)	0.32	(0.84)
805	Lobby: NE quad	8.2	45.	8.6	2.1	0.68 (	1.4)
806	Floor 1: SW quad	4.3	32.	3.4	1.5	0.61	1.6
804	Roof: air intake	0.75	2.6	(0.15)	(0.074)	(0.38)	(0.9)
807	Field blank[b]	(0.15)	(0.15)	(0.16)	(0.13)	0.50	1.2

		2378 Tetra CDF	Total Tetra CDFs	Total Penta CDFs	Total Hexa CDFs	Total Hepta CDFs	Octa CDF
803	Floor 4: NE quad	(0.34)	(0.34)	(0.39)	(0.19)	4.7	60
802	Floor 3: SE quad	(0.30)	(0.30)	(0.41)	0.60	5.3	75
801	Floor 2: SW quad	(0.38)	(0.38)	(0.34)	(0.18)	3.0	43
805	Lobby: NE quad	(0.27)	(0.27)	(0.42)	(0.42)	4.8	68
806	Floor 1: SW quad	(0.41)	(0.41)	(0.49)	(0.32)	5.4	92
804	Roof: air intake	(0.15)	(0.15)	(0.35)	(0.13)	2.8	50
807	Field blank	(0.34)	(0.34)	(0.60)	(0.27)	4.5	79

[a]The parentheses denotes none-detected. The value in parentheses is the limit of detection.

[b]A 6600 liter air volume assumed.

Table 11
Airborne Concentrations of Polychlorinated Dibenzofurans (PCDFs)
and Polychlorinated Dibenzo-p-Dioxins (PCDDs)

50 Staniford Street Office Building
Boston, Massachusetts

January 22 - 23, 1987

Sample No.	Sample Location	Surface Concentration ng/m^2					
		2378 Tetra CDF	Total Tetra CDFs	Total Penta CDFs	Total Hexa CDFs	Total Hepta CDFs	Octa CDF
815	Floor 4: NE quad	0.35	1.52	(0.045)[a]	0.45	0.62	0.74
814	Floor 2: SW quad	0.42	2.21	0.85	1.09	1.64	0.85
817	Lobby: NE quad	3.57	19.0	3.67	1.2	1.3	0.93
818	Floor 1: SW quad	1.01	5.15	1.08	0.65	0.24	(0.43)
816	Roof: air intake	0.50	2.72	0.85	0.36	1.16	0.84
UPPER GARAGE:							
811	Room 21	1.59	11.2	1.89	1.16	1.56	0.84
812	Room 11	1.09	7.59	1.39	0.69	0.53	0.40
813	Room 3	0.45	1.57	0.44	0.78	1.03	0.63
819	Field blank[b]	(0.22)	(0.22)	0.16	0.93	0.67	0.68

Sample No.	Sample Location	2378 Tetra CDF	Total Tetra CDFs	Total Penta CDFs	Total Hexa CDFs	Total Hepta CDFs	Octa CDF
815	Floor 4: NE quad	(0.41)	(0.32)	(0.070)	0.48	8.37	23.3
814	Floor 2: SW quad	(0.304)	(0.304)	(0.095)	0.76	28.6	78.5
817	Lobby: NE quad	(0.26)	(0.19)	(0.15)	0.53	17.1	49.9
818	Floor 1: SW quad	(0.28)	(0.16)	(0.15)	(0.044)	0.69	1.22
816	Roof: air intake	(0.25)	(0.25)	(0.11)	0.95	24.3	66.2
UPPER GARAGE:							
811	Room 21	(0.56)	(0.42)	(0.079)	1.40	33.2	82.7
812	Room 11	(0.43)	(0.26)	(0.095)	0.13	0.57	0.89
813	Room 3	(0.21)	(0.14)	(0.054)	0.64	19.8	55.7
819	Field blank	(0.36)	(0.36)	(0.204)	1.35	34.3	87.4

[a]The parentheses denotes none-detected. The value in parentheses is the limit of detection.

[b]A 6600 liter air volume assumed.

Table 12

Airborne Concentrations of
2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) Equivalents

50 Staniford Street Office Building
Boston, Massachusetts

February 21 - 23, 1986 and January 22 - 23, 1987

Sample Date	Sample Number	Sample Location	Conc. TCDD Equivalents pg/m^3
2/86	803	4th floor: NE quad	0.05
2/86	802	3rd floor: SE quad	0.13
2/86	801	2nd floor: SW quad	0.003
2/86	805	Lobby (room 1-N): NE quad	1.71
2/86	806	1st floor (room 1-F): SW quad	0.79
2/86	804	Roof: ambient air intake	0.07
2/86	807	Field blank	0.005
1/87	815	4th floor: NE quad	0.067
1/87	814	2nd floor: SW quad	0.19
1/87	817	Lobby (room 1-N): quad	0.78
1/87	818	1st floor (room 1-F)	0.22
1/87	811	Upper garage (room 21)	0.45
1/87	812	Upper garage (room 11)	0.26
1/87	813	Upper garage (room 3)	0.14
1/87	816	Roof: ambient air intake	0.21
1/87	819	Field blank	0.11

FIGURE 1
LAYOUT DRAWING OF FLOOR FOUR: STRATUM ONE
50 STANIFORD STREET OFFICE BUILDING
BOSTON, MASSACHUSETTS

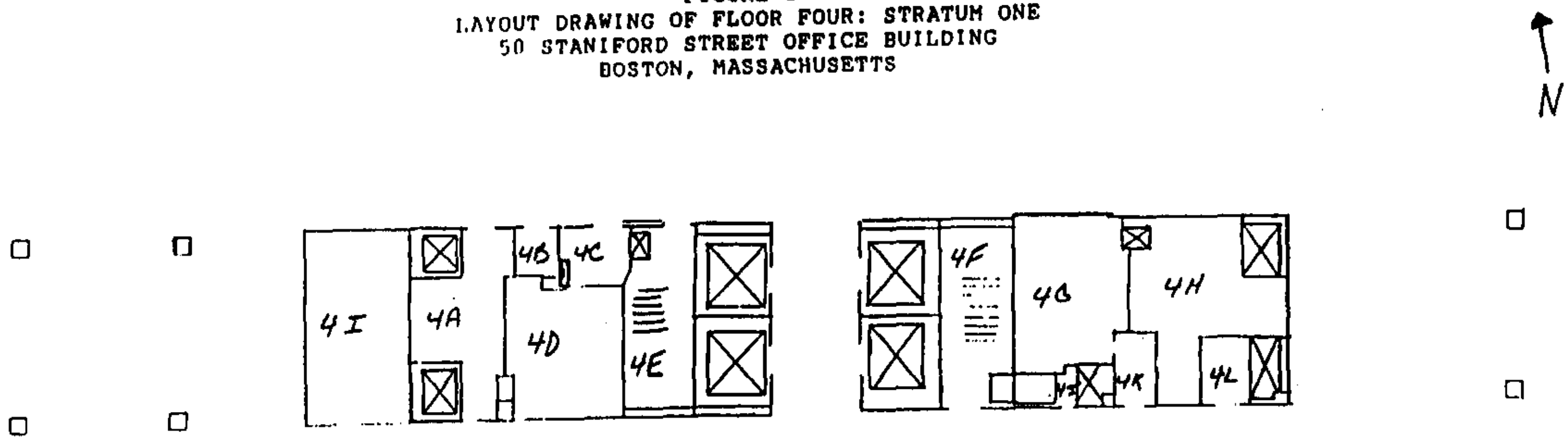
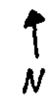


FIGURE 2
LAYOUT DRAWING OF FLOOR THREE: STRATUM ONE
50 STANIFORD STREET OFFFICE BUILDING
BOSTON, MASSACHUSETTS



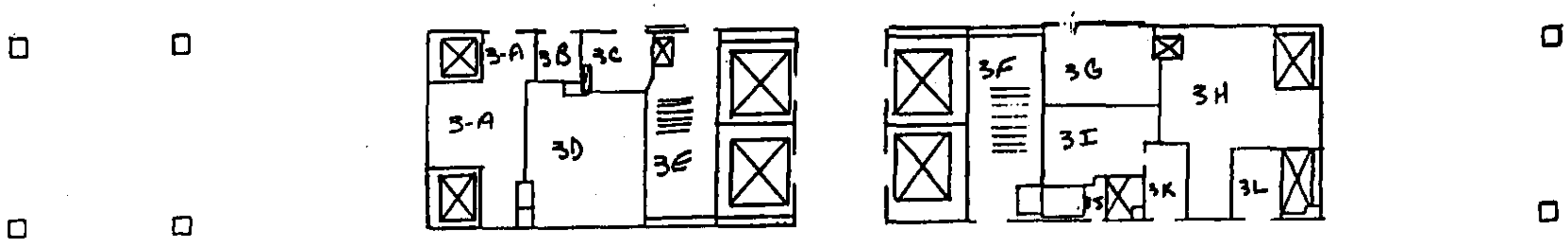


FIGURE 3
LAYOUT DRAWING OF FLOOR TWO: STRATUM ONE
50 STANIFORD STREET OFFICE BUILDING
BOSTON, MASSACHUSETTS

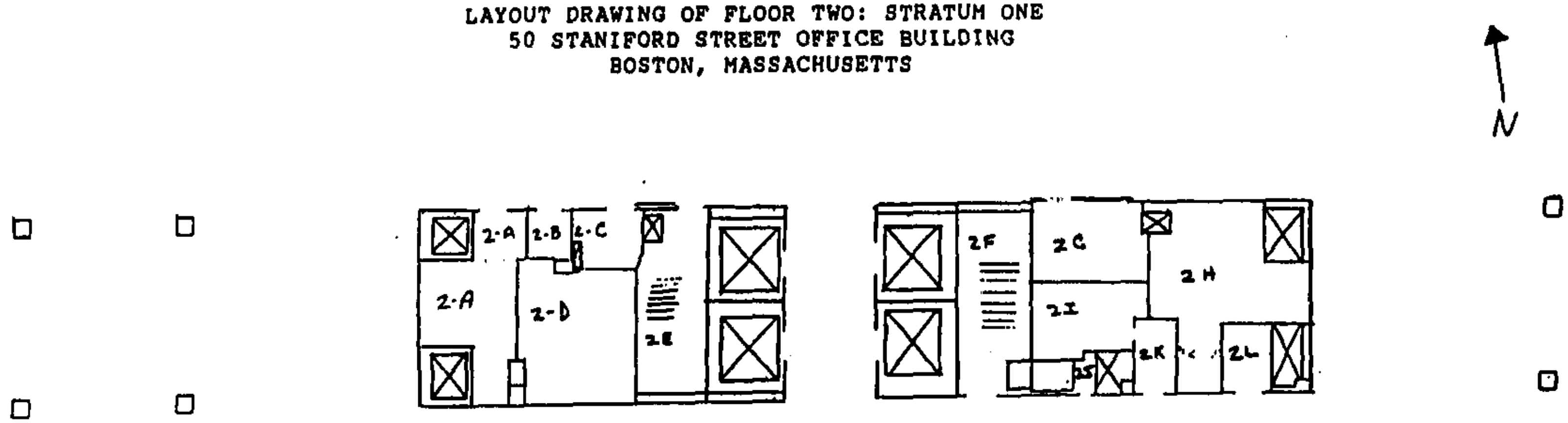


FIGURE 4
LAYOUT DRAWING OF FIRST FLOOR AND LOBBY: STRATUM TWO
50 STANIFORD STREET OFFICE BUILDING
BOSTON, MASSACHJUSETTS

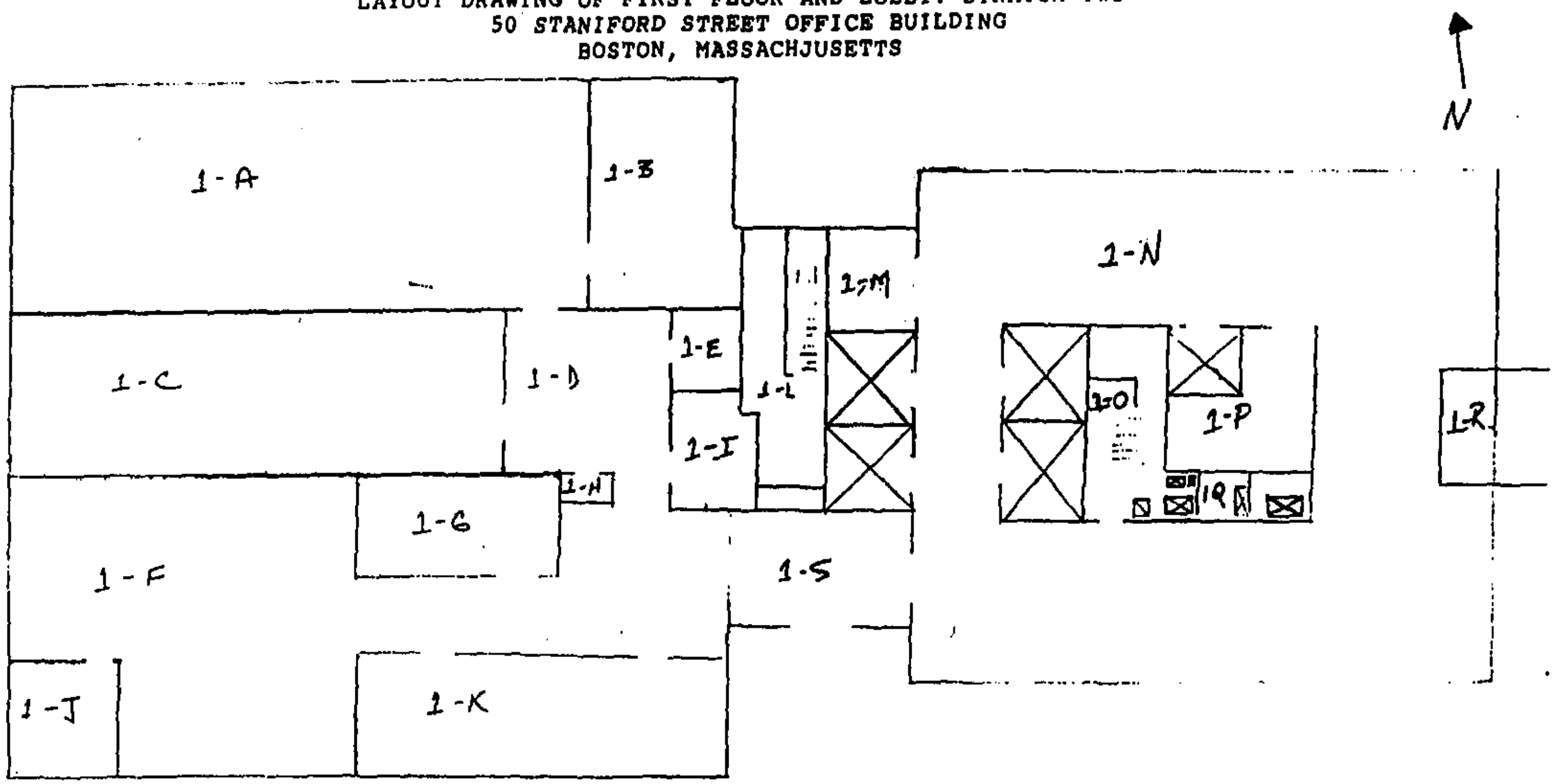


FIGURE 5
LAYOUT DRAWING OF THE UPPER BASEMENT: STRATUM THREE
50 STANIFORD STREET OFFICE BUILDING
BOSTON, MASSACHUSETTS

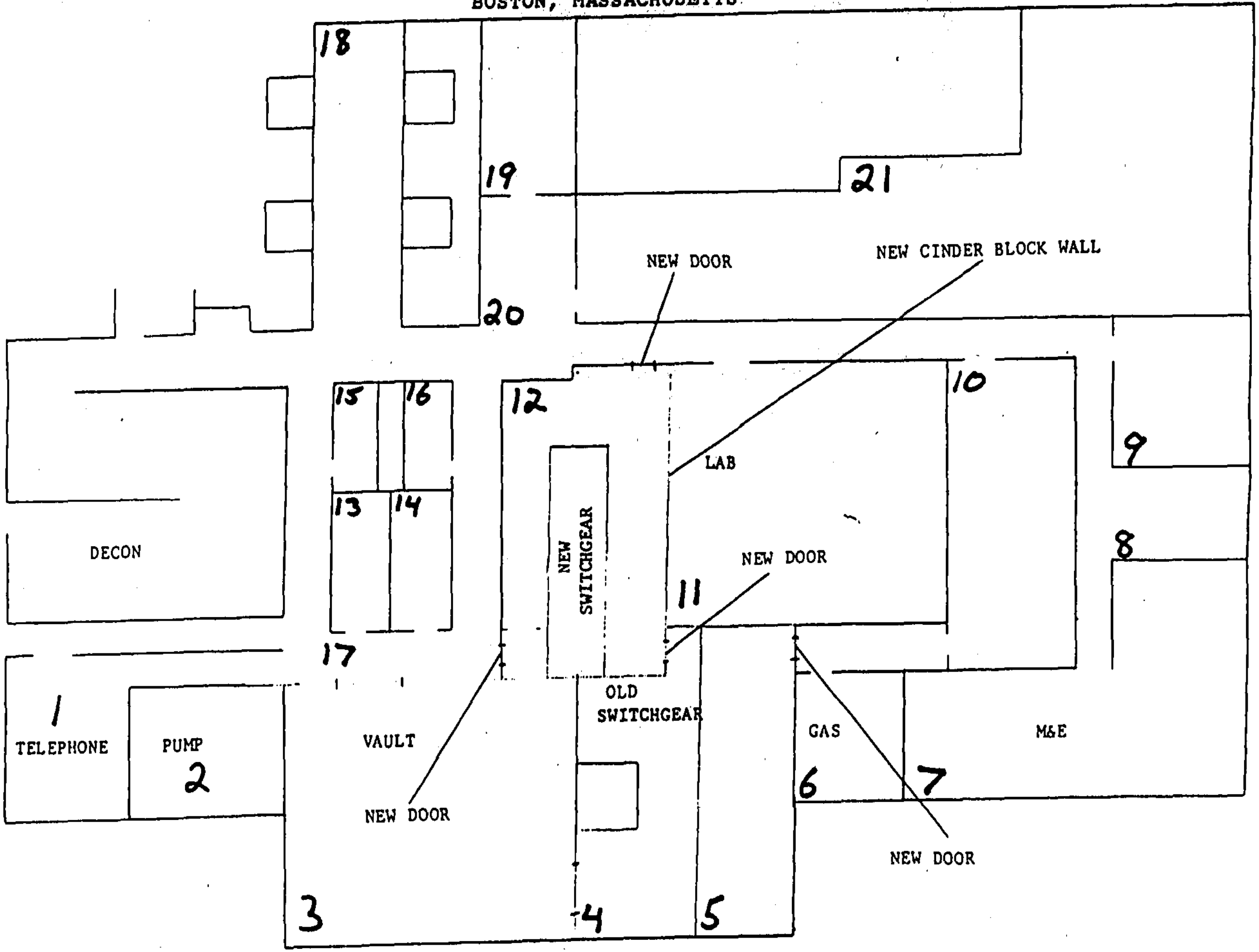


FIGURE 6
PCB Surface Concentration Frequency Distribution
50 Staniford Street Office Building, Boston, MA
February 1986 and January 1987

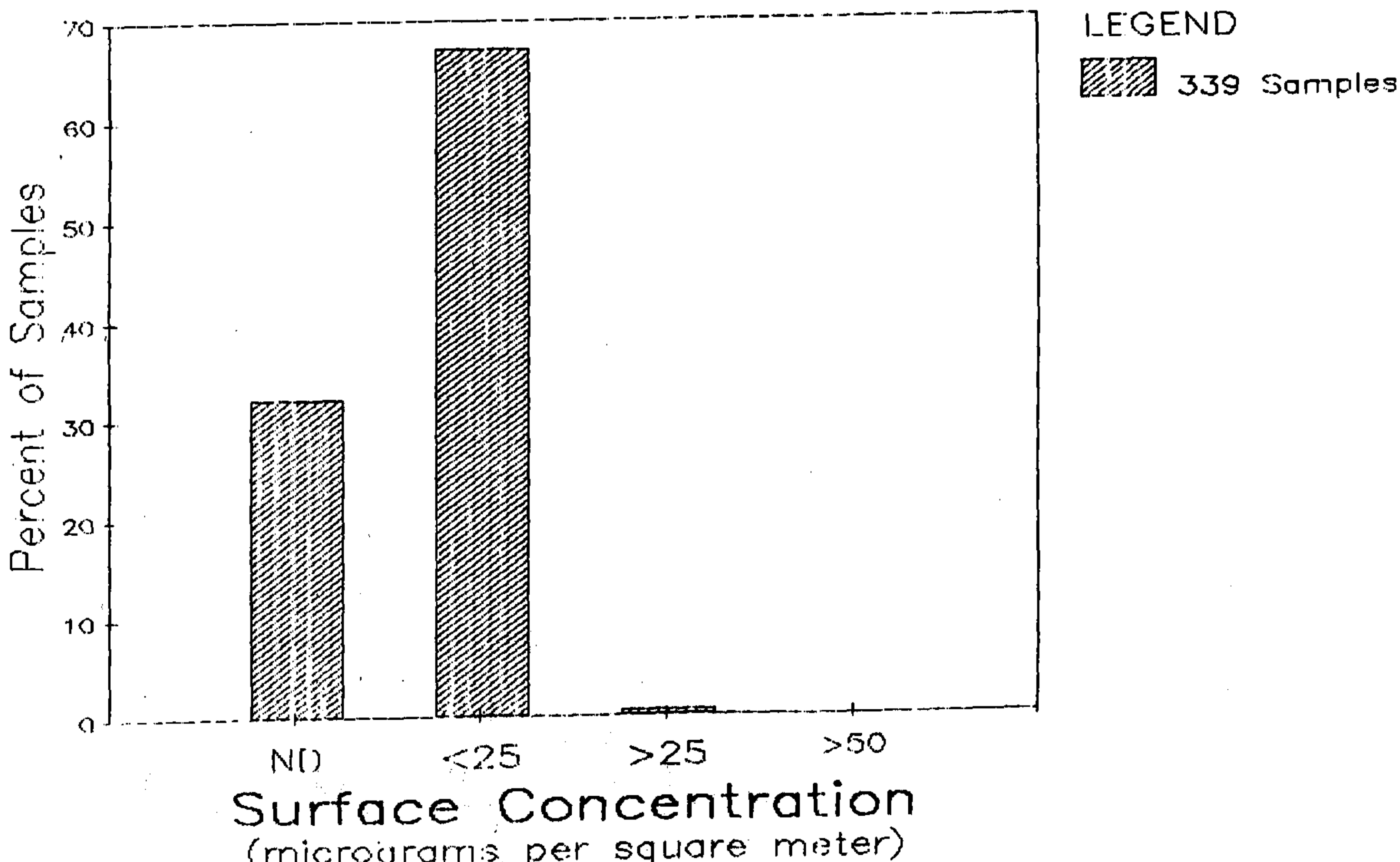


FIGURE 7
PCB Surface Concentration Frequency Distribution
Interior HVAC System Samples (Feb. 1986 & Jan. 1987)
50 Staniford Street Office Building, Boston, MA

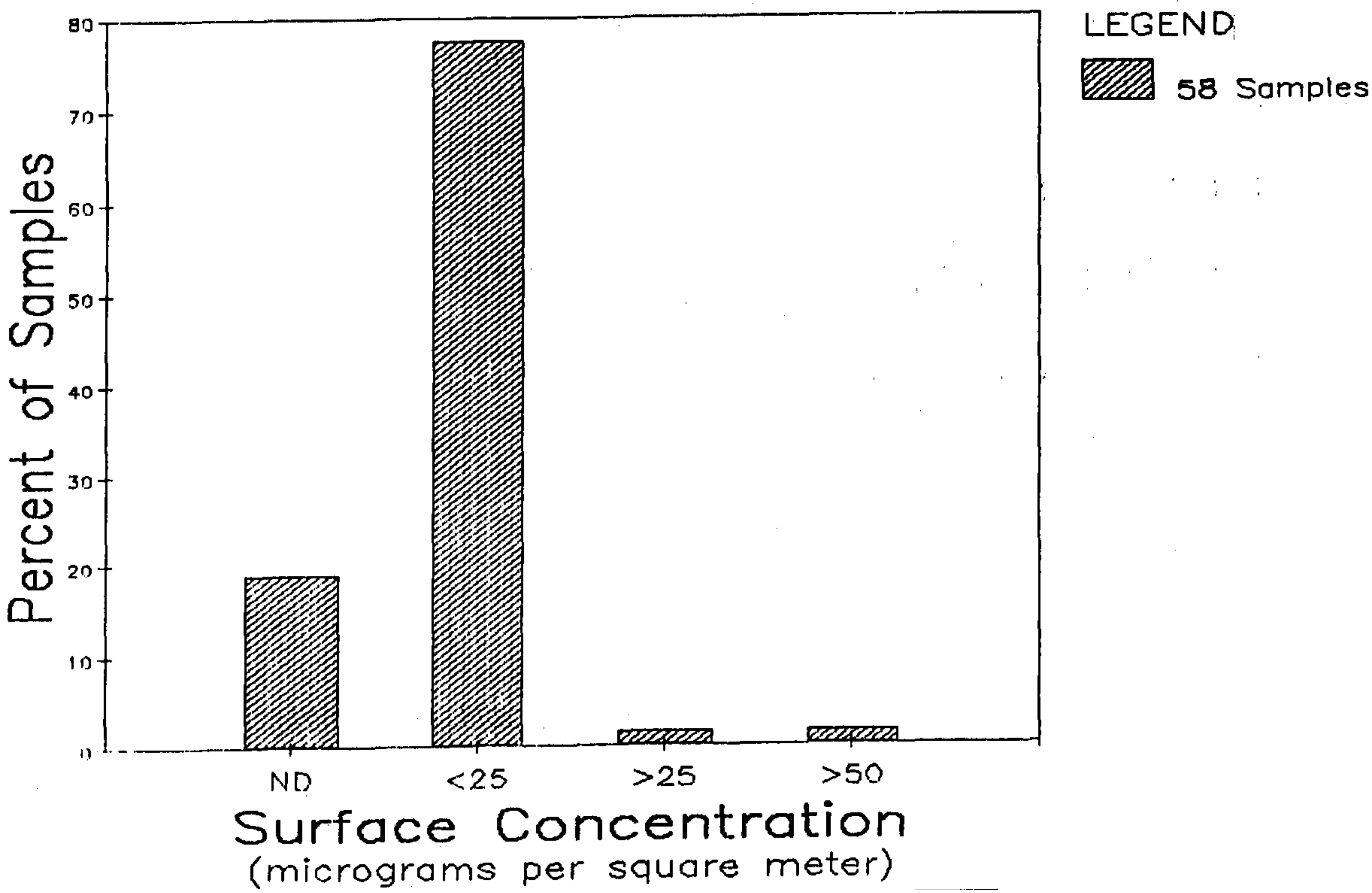
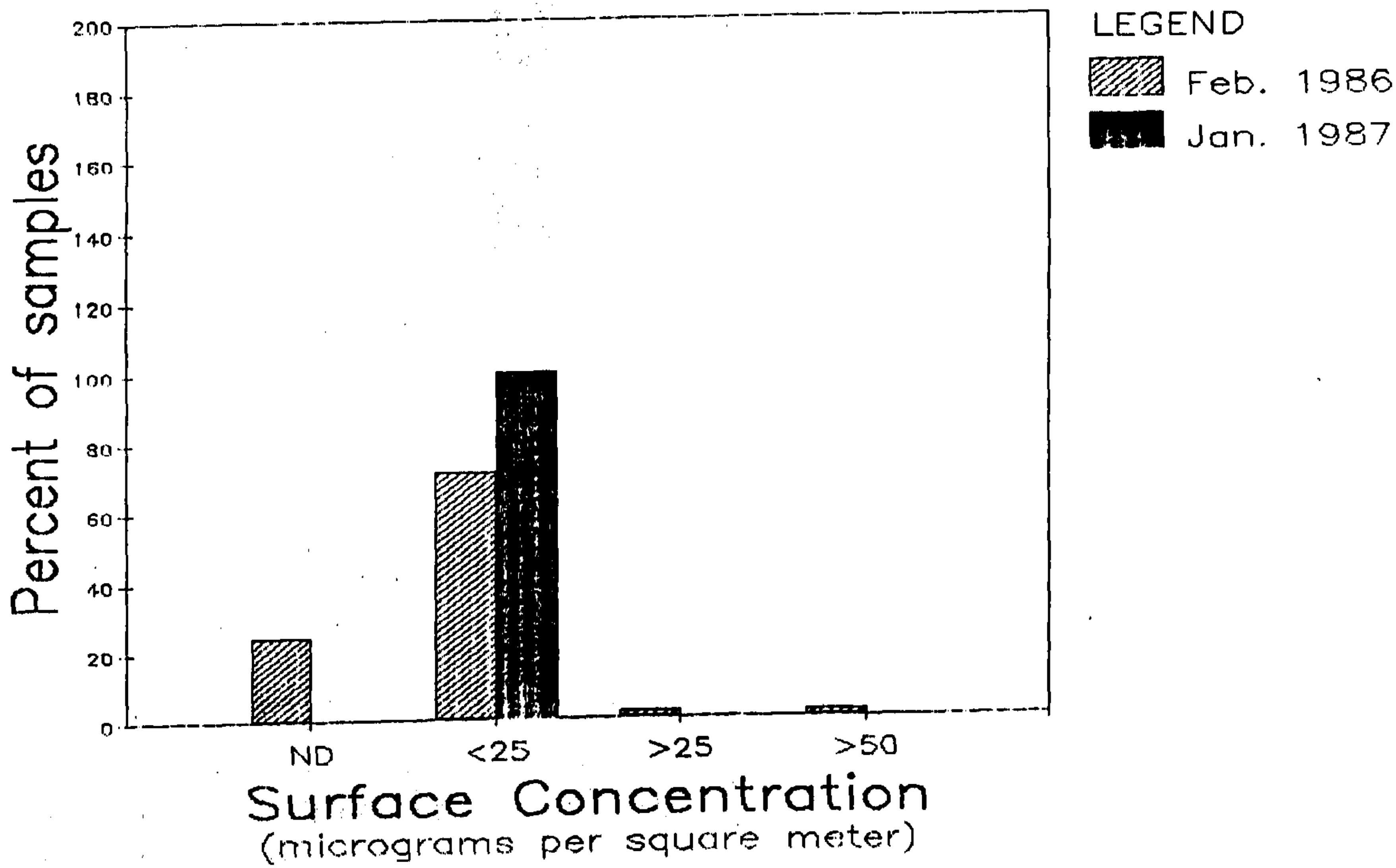


FIGURE 8
PCB Surface Concentration Frequency Distribution
Interior HVAC System Samples
50 Staniford Street Office Building, Boston, MA



APPENDIX I

Sampling Plan

A. Weighted Random Sample - PCBs

The weighted random sampling of surfaces for PCBs analysis incorporates a scheme for random sampling of locations, weighted by likely frequency of human skin contact. The different work spaces are first divided into three broad categories by occupancy or frequency of use including (1) office space, (2) hallways and reception areas, and (3) storage areas. The work surfaces are then divided into seven categories by likelihood of skin contact: floors; ceilings; high contact work surfaces such as desks and telephones; low contact work surfaces such as book shelves and file cabinets; high use wall areas such as door knobs and light switches, as well as the areas around them; high contact wall areas (between 3' and 6' above the floor) including room dividers; and low contact wall areas (below 3' and above 6' from the floor).

A system of weighting factors is developed to characterize the contact an occupant might have with each surface. The probability of selection for any given surface for the random sampling is weighted by a factor according to the frequency of contact with the surface by the worker. The weighting factors ranging from 0.05 to 1.0 are shown below:

WRS Weighting Factors

Surface	Office	Hallway	Storage
Floors	0.15	0.05	0.10
Ceilings	0.05	0.05	0.05
High Contact Work	1.0	N/A*	N/A
Low Contact Work	0.5	0.1	0.5
High Use Wall	0.5	0.3	0.5
High Contact Wall	0.4	0.2	0.3
Low Contact Wall	0.15	0.1	0.15

*N/A denotes not applicable.

To accomplish the weighted random sampling of surfaces, an inventory of the existing surfaces and structural configuration in the building is completed. Each room is assigned a designation and all of the surfaces in each room are listed on a statistical data input form. The information from the statistical data input form is entered into a computer data base and converted to weighted surfaces. A computer program reads the data base and produces a new data base of surfaces, including their areas (square feet), and then weighs the areas according to the weighting factors. This new data base of weighted areas is then randomly sampled by a computer program using a uniform random number generator to select the sampling locations.

The outcome of the analysis of the WRS data is to compute, for each strata 95%-95% upper tolerance level, Tl. This tolerance limit is a value for which there is 95% confidence that the probability of the PCB concentration for any randomly selected location in the building exceeding the value Tl is less than 5%. For each strata, it is necessary to determine the appropriate distribution to use in estimating an upper tolerance limit. The data for each strata is evaluated for Gaussian distribution using a modified version of the Shapiro and Wilks W-test [12] ($p = 0.05$).

If the W-test fails to reject the Gaussian hypothesis, then the tolerance limit is calculated by

$$Tl = X + K\,S$$

where X is the average concentration for the strata; K is the Gaussian tolerance factor [14]; and S is the sample standard deviation. The Gaussian tolerance factors for each of the three strata are shown below:

Strata	Sample Size	Tolerance Factor [14]
One	93	1.938
Two	60	
Three	93	1.938

If the calculated tolerance limit is below the cleanup guideline, then the stratum is accepted as clean.

If the W-test rejects the Gaussian Hypothesis, but accepts the log-normal, then the tolerance limit for the log-normal distribution is computed. The tolerance limit is identical to the one above, except the natural logarithm of the data is used to compute X and S, and the exponential of the above tolerance interval is used:

$$Tl = \exp\,(X + K\,S\,)$$

As before, if the tolerance limit is below the guideline, the stratum is accepted as clean.

In the case that both the Gaussian and log-normal distributions are rejected, a non-parametric tolerance limit is used. For a sample size of 93, this non-parametric tolerance limit is the second largest observed value. For a sample size of 60, this non-parametric tolerance limit is largest observed value. In this case, if no more than one observed value exceeds the cleanup guideline, the stratum is accepted as clean.

APPENDIX II

Analytical Methods

A. Air Sample Analysis - PCBs

The air samples for PCBs were analyzed by Battelle-Columbus Laboratories in Columbus, Ohio [16-17].

The glass fiber filters and florisil sticks from each PCB air sampler were extracted separately. The filters were Soxhlet extracted for 16 hours with hexane and concentrated to approximately 10 ml. Each half of the florisil stick was eluted separately with 7 ml of hexane. The front half florisil stick eluates were combined with the corresponding filter extracts and acid washed with concentrated sulfuric acid. All extracts were concentrated to 1 ml with a gentle stream of nitrogen. The back half eluates were archived in a refrigerator at 40 degree centigrade and were analyzed only if low recovery of DDE was noted in the front half analysis. These extracts were analyzed without further preparation.

The PCB sample extracts were analyzed using capillary column gas chromatography-electron capture detection. The PCB levels were quantified by comparison to standard curves which were generated from analyses of external Aroclor standards. Prior to analyzing the sample extracts, standard curves were generated for Aroclors 1242, 1254, and 1260. The standard curves covered the concentration range of 0.25 to 2.5 ug/ml. Each standard solution was analyzed in triplicate and the data were plotted using linear regression equations. The summed areas from approximately 8 - 10 chromatographic peaks were used for the quantifications. These peaks were selected so that there was a minimum of cross Aroclor interference in samples which contained multiple Aroclors.

B. Surface Sample Analysis - PCBs

The surface wipe samples were analyzed for PCBs by Data Chem Inc. in Salt Lake City, Utah.

The cotton gauze samples were prepared for PCB analysis by extraction in 40 milliliters of hexane with shaking for 30 minutes. The hexane was transferred to a concentrator tube and the gauze was rinsed twice with 10 milliliters of hexane. The concentrated hexane eluent was cleaned on a florisil column and the sample was brought to a final volume of 3 milliliters.

The PCB sample extracts were analyzed using capillary column gas chromatography with electron capture detection [9]. The presence of an Aroclor was determined by comparison with standard samples of Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260 obtained from the U.S. EPA. Quantitation was performed by summing the peak heights of the five major peaks of the standards and comparing those sums to the sums of the same peaks in the sample.

C. Surface and Air Sample Analysis - PCDFS and PCDDs

The surface wipe and air samples for PCDFs and PCDDs were analyzed by Battelle Columbus Laboratories in Columbus, Ohio [16-17].

1. Sample Extraction and Analyte Enrichment

The gauze samples were transferred to Soxhlet extraction thimbles and spiked with:

9.55 ng 2,3,7,8-tetra-CDD-$^{13}C_{12}$;
11.75 ng 1,2,3,7,8-penta-CDD-$^{13}C_{12}$;
6.25 ng 1,2,3,6,7,8-hexa CDD-$^{13}C_{12}$;
22.20 ng 1,2,3,4,6,7,8-hepta-CDD-$^{13}C_{12}$;
12.75 ng 1,2,3,4,6,7,8,9-octa-CDD$^{13}C_{12}$;
10.60 ng 2,3,7,8-tetra-CDF-$^{13}C_{12}$;
6.20 ng 1,2,3,7,8-penta-CDF-$^{13}C_{12}$;
7.50 ng 1,2,3,4,7,8-hexa-CDF-$^{13}C_{12}$;
18.75 ng 1,2,3,4,6,7,8-hepta-CDF-$^{13}C_{12}$; Benzene was added to the extractors and the samples were extracted for 18 hours. After extraction, the benzene extracts were concentrated to approximately 10 ml with 3-stage Synder columns.

The silica gel cartridge and the particulate filter from each PCDF/PCDD air sampler were transferred to separate Soxhlet extractors and extracted for 18 hours with approximately 250 ml of benzene as the solvent. Two isotopically labelled internal standards, 2.5 ng each of 2,3,7,8-tetra-CDD-$^{13}C_{12}$ and 2,3,7,8-tetra-CDF-$^{13}C_{12}$, had been spiked into the silica gel cartidges prior to sampling. Seven additional internal standards including 5 ng each of penta-CDD-$^{13}C_{12}$, hexa-CDD-$^{13}C_{12}$, hepta-CDD-$^{13}C_{12}$, octa-CDD-$^{13}C_{12}$, penta-CDF-$^{13}C_{12}$, hexa-CDF-$^{13C}{}_{12}$, and hepta-CDF-$^{13C}{}_{12}$ standards were also spiked into each sample before extraction. The benzene extracts were concentrated to approximately 10 ml with 3-stage Snyder columns.

The benzene extracts were transferred to multilayered silica gel columns containing activated silica gel, 44 percent concentrated sulfuric acid on silica gel, and 33 percent 1M sodium hydroxide on silica gel. The purpose of these columns was to remove acidic and basic compounds and easily oxidized materials for the extracts. The silica gel support provided a large surface area for contact with the sample extracts, thus improving the cleanup efficiency. The PCDF/PCDD isomers were eluted from the columns with 70 ml of hexane and the entire eluates, including the original extract volume, were collected. The benzene/hexane eluates were concentrated with a gentle stream of nitrogen gas and solvent exchanged into hexane. The hexane solutions were then fractionated with columns containing approximately 5 g of activated basic alumina using hexane/methylene chloride (97:3, v/v), and hexane/methylene chloride (1:1, v/v) as elution solvents. The 1:1 hexane/methylene chloride eluates were collected, concentrated to near dryness, and dissolved in 20 ul of n-decane containing 5 ng of an absolute recovery standard, 1,2,3,4-tetra-CDD-$^{13C}{}_{12}$. All solutions were stored a 0 C and protected from light until analyzed.

2. Analysis

The extracts were analyzed and quantified for PCDD/PCDF by combine capillary column gas chromatography/high resolution mass spectrometry (HRGC/HRMS).

3. Quality Assurance

The operation of the HRGC/HRMS was evaluated each day by analyzing standard mixtures of PCDF/PCDD isomers. These mixtures consisted of 2,3,7,8-tetra-CDD, 2,3,7,8-tetra-CDF, 2,3,7,8-tetra-CDD-$^{13C}{}_{12}$, and 2,3,7,8-tetra-CDF-$^{13C}{}_{12}$ to evaluate accuracy of quantification, mixtures of selected PCDD/PCDF isomers to evaluate the stability of the chromatographic elution windows, and tetra-CDD isomer mixtures to evaluate isomer resolution. The mass focus accuracy of the MID unit was evaluated at least every four hours by observing selected ion masses from perfluorokerosene (PFK). Adjustments were made to the offset to correct for minor variations. Mass focus stability was assured by use of a reference PFK "lock mass" to correct for any mass focus drift.

Field blank, native spike, and laboratory method blank samples were processed during the extraction and cleanup of the samples as a quality control measure. The native spike sample was used to evaluate the accuracy of quantification, while the field and laboratory method blank samples were used to evaluate if contamination occurred during sampling and analysis.

4. Recovery of Internal Standards

Recoveries of the nine internal standards (see sample extraction and analyte enrichment section) were calculated by comparison to the external standard, 1,2,3,4-tetra-CDD-$^{13C}{}_{12}$, which was added following extraction. Relative response factors were determined from triplicate analyses of a standard mixture containing the nine isotopically labelled standards. The equation used to calculate the recoveries was:

$$\text{Recovery (\%)} = \frac{\text{Ais x Qrs X 100}}{\text{Ars x Qis x Rf}}$$

where:

Ais = Sum of integrated areas for internal standard;
Qrs = Quantity of recovery standard in ng;
Ars = Sum of integrated areas for recovery standard;
Qis = Quantity of internal standard in ng; and
Rf = Response factor.

5. Quantification

The tetra-, penta-, hexa-, and hepta- PCDF/PCDD isomers were quantified by comparing the sum of the two ions monitored for each class to the sum of the two ions monitored for the corresponding isotopically labelled internal standard. The octa-CDD-$^{13C}{}_{12}$ was used to quantify the octachloro-PCDF/PCDD congener classes. Experimental relative response factors were calculated from multiple analyses of a mixture which contained representatives of the tetrachloro- through octachloro-PCDD/PCDF congener classes. These response factors were included in all calculations used to quantify the data. The response factors were calculated by comparing the sum of the two ions monitored for each congener class to the sum of the two ions monitored for the corresponding internal standard.

The formula used for quantifying the PCDD/PCDF isomers was:

$$\text{Quantity/sample} = \frac{Ac \times Qis}{Ais \times Rf}$$

where:

Quantity = total quantity of target isomer or congener class;
Ac = sum of integrated areas for the target isomer or congener class;

Qis = quantity of internal standard;
Ais = total integrated areas for the internal standard; and
Rf = response factor.

Each pair of resolved peaks in the selected-ion-current chromatograms was evaluated manually to determine if the criteria for a PCDD and PCDF isomer were met. By examining each pair of peaks separately, quantitative accuracy was improved over that obtained when all of the peaks in a selected chromatographic window are averaged. When averaged data are used, pairs of peaks with high and low chlorine isotope ratios may produce averaged data that meets the isotope ratio criterion. For example, two pairs of peaks having chlorine isotope ratios of 0.56 and 0.96, both outside of the acceptable range, would have an average ratio of 0.76.

The criteria that were used to identify PCDD and PCDF isomers were:

(1) Simultaneous responses at both ion masses;
(2) Chlorine isotope ration within $\pm$ 15% of the theoretical value;
(3) Chromatographic retention times within windows determined from analyses of standard mixtures;
(4) Signal to noise ratio equal to or greater than 2.5. to 1.

The 2,3,7,8-tetra-CDD/CDF isomers and the octa-CDD included the additional criterion that they eluted within $\pm$ 2 seconds of their isotopically labelled analogs.

The quantification of 2,3,7,8-tetra-CDD using the gas chromatographic column employed is not affected by contributions from other isomers. The value for 2,3,7,8-tetra-CDF, however, may include contributions from 1,2,4,9-tetra-CDF, 2,3,4,7-tetra-CDF, 2,3,4,6-tetra-CDF, and 2,3,4,8-tetra-CDF which closely elute on the nonpolar stationary phase capillary column used for these analyses. These isomers can be fully separated by using a polar stationary phase capillary column but this would require separate analysis.

A limit of detection (LOD) was calculated for samples in which isomers of a particular chlorine congener class were not detected. The formula used for calculating the LOD was:

$$\text{LOD/sample} = \frac{\text{Hc x Qis x 2.5}}{\text{His x Rf}}$$

where:

LOD = Single isomer limits of detection for a congener class;
Hc = height of congener class isomer;
Qis = Quantity of internal standard;
His = peak height of internal standard; and
Rf = response factor.