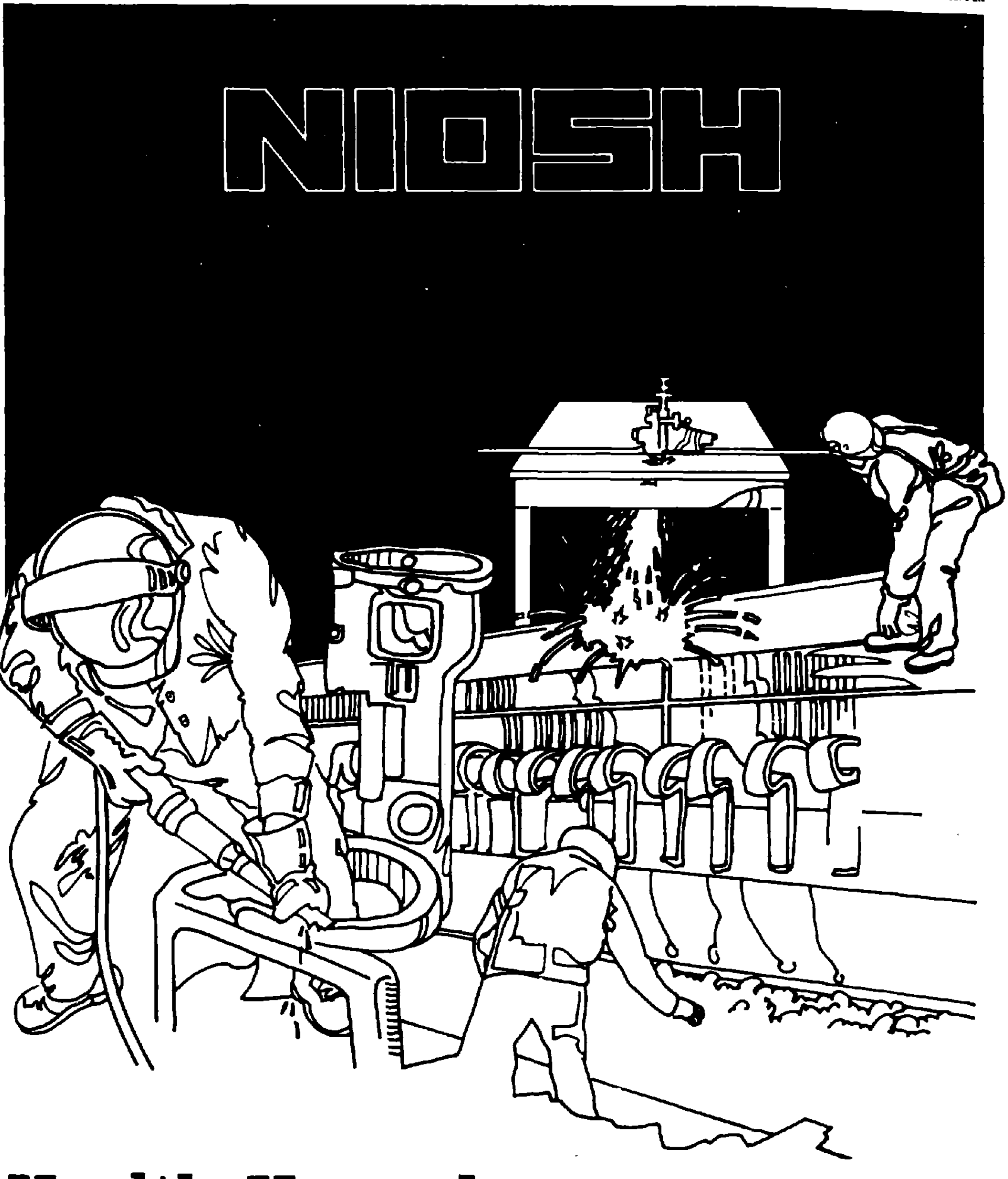
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 85-072-1850
SEATTLE PUBLIC SCHOOLS
SEATTLE, WASHINGTON

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

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

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO.	2.	3. Recipient's Accession No. PB88-203724
4. Title and Subtitle Health Hazard Evaluation Report No. HETA-85-072-1850, Seattle Public Schools, Seattle, Washington			5. Report Date 87/11/00
			6.
7. Author(s) Kominsky, J. R.			8. Performing Organization Rept. No. HETA-85-072-1850
9. Performing Organization Name and Address Hazard Evaluations and Technical Assistance Branch, NIOSH, U.S. Department of Health and Human Services, Cincinnati, Ohio			10. Project/Task/Work Unit No.
			11. Contract(C) or Grant(G) No. (C) (G)
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered
			14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

In response to a request from the State of Washington Division of Health Services, an investigation was made of possible polychlorinated-biphenyl (1336363) (PCB) contamination at the Catherine Blaine School (SIC-8211), Seattle, Washington. In October of 1984 ballast burnouts had occurred in three classrooms at the school, resulting in high concentrations of PCBs in the air and on surfaces in these rooms. PCB concentrations ranged from 0.19 to 2.4 micrograms/100 square centimeters (microg/100cm2) in surface samples taken in the three Blaine School classrooms. Concentrations ranged from 0.25 to 1.2microg/100cm2 in classrooms without reported incidents of ballast burnout. Air samples in the three classrooms showed PCB concentrations ranging from 0.8 to 1.2micrograms/cubic meter (microg/m3). In two other schools, Ingraham and Bryant, where burnout incidents had been reported, PCBs were not detected in 11 surface samples taken from rooms which had burnouts nor in eight samples where burnouts had not occurred. In a third school, Seward, where burnouts occurred, PCBs were detected in a range of less than 0.1 to 3.1microg/100cm2. In both the Blaine and Seward schools the PCB concentrations on surfaces coming into contact with the skin were generally nondetectable. The author concludes that the contamination does not present an immediate health risk to students or faculty. Recommendations are offered for the proper cleanup procedure to follow when a PCB containing ballast fails.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

NIOSH-Publication, NIOSH-Author, NIOSH-Health-Hazard-Evaluation, NIOSH-Technical-Assistance-Report, Hazard-Unconfirmed, HETA-85-072-1850, Region-10, Fluorescent-lighting, Lighting-systems, Chlorinated-hydrocarbons, Air-sampling

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages 32
	20. Security Class (This Page)	22. Price A03 12.95

(See ANSI-Z39.18) See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

HETA 85-072-1850
NOVEMBER 1987
SEATTLE PUBLIC SCHOOLS
SEATTLE, WASHINGTON

NIOSH INVESTIGATORS:
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I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) was requested by the State of Washington Division of Health Services to provide assistance in conducting an assessment of polychlorinated biphenyl (PCB) contamination associated with electrical burnout of in service fluorescent light ballasts at the Catherine Blaine School in Seattle, Washington. In November 1984 a private contractor reported high concentrations of PCBs on surfaces and in air in three classrooms at the Blaine School where ballast burnouts had occurred on October 16, 1984. On November 19-20, 1984, investigators from NIOSH and the Washington Division of Health repeated air and surface testing in the Blaine School and three other schools (Ingraham, Bryant and Seward) where ballast burnouts had occurred more recently.

Using a detection limit of 0.1 ug/100 cm^2, PCBs were found to be present in 10 of 16 surface samples taken in the three Blaine School classrooms (range 0.19 to 2.4 ug/100 cm^2) and in 6 of 18 surface samples from 13 Blaine School classrooms without reported incidents of ballast burnout (range 0.25 to 1.2 ug/100 cm^2). In the Blaine School, measurable airborne concentrations of PCBs were found in 3 of 3 classrooms where the burnouts occurred (range 0.8 to 1.2 ug/m^3) and non-detectable concentrations (<0.55 ug/m^3) in 0 of 2 classrooms without ballast burnouts. Seven of seven classrooms with incidents of burnout and 1 of 1 classrooms without incidents of burnout in Ingraham, Bryant and Seward Schools showed non-detectable air concentrations of PCBs (<0.55 ug/m^3). In 11 surface samples from six classrooms with burnouts and eight samples from four classrooms without ballast burnouts in the Ingraham and Bryant Schools, PCBs were not detected in any of the samples at a detection limit of <0.1 ug/100 cm^2. In the Seward School, PCBs were detected in 1 of 1 classrooms with a burnout incident (range <0.1 to 1.0 ug/100 cm^2) and 2 of 2 classrooms with burnouts (range <0.1 to 3.1 ug/100 cm^2).

Based upon the results of this evaluation, the NIOSH investigator concluded that electrical burnout of fluorescent light ballast can result in air and surface concentrations of PCBs above comparative background levels. However, based on the low level of potential exposure and the low acute toxicity of PCBs, a significant human health risk is not likely to be associated with having been in one of these rooms for a short period of time after electrical burnout of a ballast. However, to prevent continued respiratory and dermal exposure to PCB, the rooms should be ventilated and localized cleanup of surfaces completed. NIOSH considers PCBs to be potential human carcinogens, thus, recommends the systematic removal of all PCB-containing ballasts.

KEYWORDS: SIC 8211 (Elementary and Secondary Schools), polychlorinated biphenyls, (PCBs), fluorescent light ballast, ballast burnout, indoor air.

II. INTRODUCTION

On November 16, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request from the State of Washington, Department of Social and Health Services for assistance in conducting an assessment of polychlorinated biphenyl (PCB) contamination at the Catherine Blaine Elementary School in Seattle, Washington. The request was prompted by a consultant's report that showed elevated air and surface concentrations of PCBs in three rooms that had experienced fluorescent light ballast burnout [1]. These rooms (Nos. 121, 134 and 140) showed PCB surface concentrations ranging from 1.7 to 8000 ug/12.5 cm^2 (arithmetic mean 1175 $\pm$ 2319) and airborne concentrations ranging from 1 to 4 ug/m^3 (arithmetic mean 2.7 $\pm$ 1.5). Rooms that had not experienced ballast burnout showed both non-detectable surface (<0.2 ug/12.5 cm^2) and airborne (detection limit not specified) concentrations.

On November 19-20, 1984, investigators from NIOSH and the State of Washington Division of Health Services conducted an environmental survey to assess both air and surface concentrations of PCBs at the Catherine Blaine School and three other schools in Seattle including Seward, Ingraham and Bryant, which reported recent incidents of ballast burnout. The results of the survey and corresponding recommendations were presented to the Seattle Public Schools District in Interim Report No. 1 in December 1984. On March 3-5, 1985, a follow-up survey was conducted to further assess the air and surface concentrations at the Catherine Blaine and Seward Schools. The results of the latter survey were presented in a letter report dated April 28, 1985.

III. BACKGROUND

A fluorescent light consists of a fixture, fluorescent lamps, and what is technically known as a ballast resistor. The purpose of the ballast is to compensate for variations in the voltage of the electrical supply to the fixture.

Typical ballasts contain a reactor (a core and coil assembly), a capacitor, and, in those manufactured after 1970, a thermal protector. The thermal protector within the ballasts de-energizes the circuit when the internal temperature exceeds 105°C. The housing of a typical ballast for two 40 watt lamps is approximately 20 gauge carbon steel measuring 8.5 inches in length and 2.3 inches in width. The entire airspace inside the ballast and around the reactor and capacitor is occupied with an asphalt mixed with a very fine silica powder. This asphalt compound acts as a heat transfer medium, a protective coating against moisture for the electrical parts, and as a medium for acoustic attenuation.

Ballast of most fluorescent light fixtures manufactured before 1978 have capacitors that contain a dielectric (electrical insulating) fluid that consists of approximately 100% PCBs. Ballasts manufactured prior to 1958 contained Aroclor 1254 and those until 1978 contained Aroclor 1242. (Aroclor 1254 and 1242 is a commercial mixture of PCBs with approximately 54 and 42 weight percent chlorine, respectively.) The quantity of PCBs varies with the ballast rating. A ballast capacitor used for two four-foot fluorescent lamps would contain approximately 23.6 grams, or 17.2 milliliters (about an ounce) of PCBs. Much of the PCBs in the capacitor is absorbed by several layers of paper.

Ballast burnout occurs when an electrical malfunction internal to the ballast causes a dramatic increase in temperature and ultimately ends with breaking of the electrical circuit. Thermal runaway occurring during burnout may cause the asphalt potting compound to volatilize releasing an acid smoke and objectionable odor. Symptoms including headache, eye irritation, sore throat, nasal congestion, and nausea have been reported to be associated with exposures to contaminants during electrical burnout of fluorescent light ballasts [2]. The elevated temperatures associated with ballast burnout can cause the asphalt compound to soften and leak through the openings in the ballast casing. The leaked material can contain percent concentrations of PCBs [3].

IV. STUDY DESIGN AND METHODS

A. Study Design

The November 19-20, 1984, survey focused on assessing the PCB contamination associated with three incidents of ballast burnout that occurred on October 16, 1984, at the Catherine Blaine School. Limited assessments also were completed at the Bryant, Ingraham and Seward Schools as a result of single incidents of ballast burnout that occurred on November 15, 16, and 19, respectively. The March 3-5, 1985, survey was conducted to assess the overall surface contamination in the Catherine Blaine and Seward Schools.

Samples were obtained to determine the surface and airborne concentrations of PCBs both in rooms that had and had not experienced an incident of ballast burnout. The surface measurements were made on high skin contact and elevated horizontal surfaces. High skin contact surfaces are those with which a person would probably have frequent and/or prolonged direct dermal contact such as desks, tables, and counters. Elevated horizontal surfaces are those surfaces at a height of greater than six feet above the floor. Typical elevated horizontal surfaces included tops of ventilation ducts and pipes, top of storage cabinets, and in the case of the Catherine Blaine School, saw-tooth window ledges.

B. Sampling and Analytical Methods

1. Air and Surface Sampling Methods

Air samples for PCBs were collected using NIOSH Method 5503 [4]. The method involves a two-stage sampling device consisting of a 13-mm glass fiber particulate filter proceeded by 150 mg of florisil absorbent (100 mg front and 50 mg back sections). The samples were collected using constant flow vacuum pumps at a flowrate of 0.20 or 0.55 liters per minute (L/min) for approximately 500 minutes.

Surface wipe samples for PCBs were collected using 2" x 2" soxhlet extracted cotton gauze pads, which were wetted with 4-ml of pesticide grade hexane prior to sampling. The sampling procedure consisted of marking off a surface into a 100 cm^2 area using a template or a metal tape measure. Each 100 cm^2 area was wiped, with a gauze pad held with a gloved-hand, in two directions; the second direction was performed at a 90° angle to the first direction. The gauze pad sample was then placed in a glass sample container equipped with a Teflon-lined lid.

2. Air and Surface Analytical Methods

The gauze samples were prepared for analysis by extraction in 10 milliliters of isooctane. The concentrated isooctane eluant was cleaned on a florisil column and the sample was brought to a final volume of 1 milliliter.

The florisil tubes were separated into A and two B sections. Each section was desorbed in 1 milliliter of toluene with sonication for one hour. The glass fiber filters were desorbed in 1 milliliter of toluene with sonication for one hour.

The gas chromatographic analysis was performed on a Hewlett-Packard Model 5711A gas chromatograph equipped with an electron capture detector and accessories for capillary column capabilities. A 25 m x 0.31 mm fused silica WCOT capillary column coated internally with DB-5 was used with temperature programming from 210°C (held for two minutes) to 310°C at a rate of 8°C/minute. Five percent methane in argon was used as the carrier gas. The injector was operated in the splitless mode of operation.

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 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.

The surface concentrations are reported as micrograms PCB per 100 square centimeters (ug/100 cm^2). The analytical limit of detection for all of the samples is 0.1 ug/100 cm^2.

The airborne concentrations are reported as micrograms of PCBs per cubic meter of air samples (ug/m^3). The analytical limit of detection for all of the samples is 0.05 ug per sample, which is equivalent to a volume adjusted limit of detection of approximately 0.5 and 0.15 ug/m^3, respectively.

V. EVALUATION CRITERIA

A. Toxicology

Commercial PCBs are mixtures of isomers of chlorinated biphenyls. PCBs were manufactured in the United States and marketed under the trade name Aroclor according to the average percent chlorine content of the mixture. The Aroclor products were designated by numbers such as 1221, 1242, 1248, 1254, and 1260, with the last two digits representing the approximate percent by weight of chlorine in the mixtures. Aroclor 1016, however, contained approximately 41% chlorine.

The International Agency for Research on Cancer has concluded that the evidence for PCBs' carcinogenicity to animals and to humans is limited. Certain polychlorinated biphenyls are carcinogenic to mice and rats after their oral administration, producing benign and malignant liver neoplasms. Oral administration of polychlorinated biphenyls increased the incidence of liver neoplasms in rats previously exposed to N-nitrosodiethylamine [5].

In a mortality study among workers at two capacitor manufacturing plants in the United States [6] a greater than expected number of observed deaths from cancer of the liver and cancer of the rectum were noted. Neither increase was statistically significant for both study sites combined. However, in a recent update of this study, with follow-up through 1982, the excess in liver/biliary tract cancer was statistically significant (5 observed vs. 1.9 expected)/ whereas, the excess in cancer of the rectum was still elevated but not statistically significant. In a mortality study among workers at a capacitor manufacturing plant in Italy [7] males had a statistically significant increased number of deaths from all neoplasms. When analyzed separately by organ system, death from neoplasms of the digestive organs and peritoneum (3 observed vs. 0.88 expected) and from lymphatic and hematopoietic tissues (2 observed vs. 0.46 expected) were elevated. This study was recently expanded to include all workers with one week or more of employment with vital status follow-up through 1982. In the updated results, there was a statistically significant excess in cancer among both females (12 observed vs. 5.3 expected) and males (14 observed vs. 7.6 expected). In both groups there were non-significant excesses in lymphatic/hematopoietic cancer and a statistically significant excess in digestive cancer among males (6 observed vs. 2.2 expected). Unfortunately, not enough information is provided to determine the risk specifically for liver cancer.

B. Exposure Criteria

The National Institute for Occupational Safety and Health (NIOSH) recommends that exposure to PCBs in the workplace be limited at or below the minimum reliable detectable concentration of 1 ug/m^3 determined as a time-weighted average for up to a 10-hour workday, 40-hour workweek. The NIOSH recommended exposure limit (REL) was based on the findings of adverse reproductive effects in experimental animals, on the conclusion that PCBs are carcinogens in rats and mice and, therefore, potential human carcinogens in the workplace, and on the conclusion that human and animal studies have not demonstrated a level of exposure to PCBs that will not subject the worker to possible liver injury [8,9]. Background concentrations of airborne PCBs measured in commercial office buildings [10,11] ranged from non-detected (<0.02 ug/m^3) to 0.33 ug/m^3.

The Occupational Safety and Health Administration (OSHA) promulgated its permissible exposure limit (PEL) of 1 mg/m^3 for airborne chlorodiphenyl products (PCBs) containing 42% chlorine and 0.5 mg/m^3 for chlorodiphenyl products containing 54% chlorine determined as 8-hour time-weighted average (TWA) concentrations based on the 1968 Threshold Limit Values (TLVs) of the American Conference of Governmental Industrial Hygienists (ACGIH).[12] The TLVs, which have remained unchanged at 1 mg/m^3 and 0.5 mg/m^3 through 1986, are based on the prevention of liver injury in exposed workers. The OSHA PEL and the ACGIH TLV include a "Skin" notation which refers to the potential contribution to overall exposure by the cutaneous route.

There are no NIOSH RELs, OSHA PELs or ACGIH TLVs for assessing exposure from surfaces contaminated with PCBs. Data collected by NIOSH investigators show that concentrations of PCBs present as normal levels of background contamination in commercial office buildings ranged from non-detected (<1 ug/m^2) to 21 ug/m^2 (mean 9 ug/m^2) on high skin contact surfaces, and 3 to 110 ug/m^2 (mean 18 ug/m^2) on elevated horizontal surfaces [11]. Based upon these data and other data collected by NIOSH investigators, a surface guideline of 50 to 100 ug/m^2 is used by NIOSH investigators to assess exposure to PCBs on surfaces in commercial office buildings. U.S. EPA (Federal Register, April 2, 1987, page 10688) has recommended a cleanup criteria of 10 ug/100 cm^2 for high skin contact surfaces contaminated with PCBs. In interpretation of these guidelines, it should be noted that there is a great deal of scientific uncertainty about the potential human risks from exposure to PCBs.

VI. RESULTS AND DISCUSSION

A. Airborne PCB Concentrations

The airborne concentrations of PCBs measured in 11 classrooms with reported incidents of ballast burnout and 3 classrooms without incidents of burnout are presented in Table 1. Of these 11 classrooms, 3 were in Blaine, 2 in Seward, 2 in Ingraham, and 4 in Bryant Schools. Three of the 11 classrooms showed measurable airborne concentrations of PCBs; all of these classrooms with elevated concentrations were in the classrooms with ballast burnout at the Blaine School. The airborne concentrations of PCBs ranged from 0.74 to 1.2 ug/m^3 (mean 0.92 $\pm$ 0.24 ug/m^3. The two comparison rooms at Blaine did not show detectable airborne concentrations of PCBs at a detection limit of <0.51 ug/m^3.

These concentrations represent a sampling point on the respective airborne PCB decay curves at approximately 34-days after burnout occurred. Thus, these concentrations are lower than those at the time of burnout and shortly thereafter. Figure 1 shows that the concentrations measured in these rooms at 7-days after burnout were higher in all three rooms. The airborne concentration measured in these same rooms on March 5, 1988 (approximately 140-days after burnout) showed that two of the three rooms still had concentrations higher than the comparison rooms (Table 2). The concentrations were 0.42 ug/m^3, 0.27 ug/m^3 and non-detected (<0.15 ug/m^3). The comparison class rooms without reported incidents of ballast burnout showed non-detectable concentrations of PCBs at a detection limit of <0.15 ug/m^3. These findings are generally similar to another study [13] of a single ballast burnout incident that showed PCB concentrations of 11.6 ug/m^3 initially, 1.3 ug/m^3 at 31-days and 0.50 ug/m^3 at 61-days after the ballast burnout.

These data show that under certain circumstances, incidents of fluorescent light ballast burnout can release PCBs that result in air concentrations above comparable background concentrations. The concentrations released can exceed the NIOSH REL (1 ug/m^3) for periods of several weeks and remain elevated above comparable background concentrations from several months.

B. Surface PCB Concentrations

1. Comparison of Rooms With and Without Ballast Burnouts

The concentrations of PCBs were measured on both high skin contact and elevated horizontal surfaces at Ingraham (Table 3), Bryant (Table 3), Seward (Table 5) and Blaine (Table 6) Schools. The concentrations were non-detected (<0.1 ug/100 cm^2) in all samples collected at Ingraham and Bryant Schools. The samples collected at the Seward School showed non-detectable (<0.1 ug/100 cm^2) concentrations on high skin contact surfaces and detectable concentrations in three of three samples obtained from elevated horizontal surfaces. These concentrations ranged from 1 to 3.1 ug/100 cm^2 (mean 2 ug/100 cm^2). Two samples showing concentrations above 1 ug/100 cm^2 were obtained in Room 2, which experienced a ballast burnout on October 16, 1984.

The surface concentrations of PCBs measured in three classrooms with and nine classrooms without ballast burnout at the Blaine School are summarized in Table 6. The grouped data show that the concentrations in classrooms with burnout ranged from non-detected (<0.1 ug/100 cm^2) to 2.4 ug/100 cm^2 (mean 0.57 $\pm$ 0.82 ug/100 cm^2), whereas, the classrooms without burnout ranged from non-detected (<0.1 ug/100 cm^2) to 1.2 ug/100 cm^2 (mean 0.23 $\pm$ 0.36 ug/100 cm^2).

The concentrations of PCB measured on high skin contact and elevated horizontal surfaces in the classroom with and nine classrooms without ballast burnout at the Blaine School are summarized in Table 7. The concentrations are higher than on high skin contact surfaces in both classrooms with and without ballast burnout. However, the concentrations shown by the samples collected on high skin contact surfaces in the classrooms with ballast burnout may not be indicative of the initial contamination concentrations that existed. The measurements were made approximately 34-days after burnout. Thus, the concentrations on high skin contact surfaces were probably reduced, by normal use of the surfaces and janitorial activities.

2. Overall PCB Surface Contamination at the Blaine and Seward Schools

The results of the samples collected on March 3-5, 1985, to further assess the overall PCB concentrations on surfaces in the Catherine Blaine and Seward Schools, are presented in Tables 8 and 9, respectively.

The sample results of the November 1984 and March 1985 are summarized in Table 10. In both the Blaine and Seward Schools the samples obtained on high skin contact surfaces showed detectable concentrations of PCBs in 24% (7/29) and 7% (1/15) of the samples, respectively. The samples in Blaine showed concentrations that ranged from <0.05 to 0.66 ug/100 cm^2 (mean 0.09 ug/100 cm^2). The one sample in Seward above the detection limit showed a concentration of 0.71 ug/100 cm^2. The samples obtained on elevated horizontal surfaces in Blaine showed measurable concentrations in 88% (30/34) of the samples and in Seward 53% (8/15) of the samples showed measurable concentrations. In the Blaine School, the concentrations on elevated horizontal surfaces ranged from non-detected (<0.05 ug/100 cm^2) to 32 ug/100 cm^2 with a mean of 4.4 ug/100 cm^2; 15 of these samples showed concentrations above 1 ug/100 cm^2. Of these 15 samples, the samples (Tables 5 and 8) showing the highest concentrations (ranged 1.6 to 32 ug/100 cm^2, mean 16 ug/100 cm^2) were all collected on the saw-tooth window-ledge in the main corridor of the School. These concentrations exceeded both the guidelines used by NIOSH investigators (0.5 to 1.0 ug/100 cm^2) and U.S. EPA PCB spill cleanup criteria of 10 ug/100 cm^2. In the Seward School the concentrations on elevated horizontal surfaces ranged from <0.05 to 9.1 ug/100 cm^2 with a mean of 1.5 ug/100 cm^2. Six of these samples (Tables 5 and 10) showed concentrations (range 1.8 to 9.1 ug/100 cm^2, mean 3.5 ug/100 cm^2) above 1 ug/100 cm^2.

Overall, the sample results for these two schools show that the PCB concentrations on high skin contact surfaces are generally non-detected with all detectable concentrations below 1 ug/100 cm^2. The elevated horizontal surfaces show a consistent presence of PCBs, with concentrations exceeding 10 ug/100 cm^2 in the main corridor area of the Blaine School. The elevated horizontal surfaces in Seward showed concentrations above 1 ug/100 cm^2. Therefore, in both schools the contamination concentrations above 1 ug/100 cm^2 appeared to be limited to elevated horizontal surfaces, where there is low potential for skin contact; thus, the contamination does not present an immediate health hazard to the students or faculty.

VII. CONCLUSIONS

1. Electrical burnout of in service fluorescent light ballasts manufactured prior to 1978 can result in airborne and surface concentrations of PCBs above comparative background levels.

2. Although the air levels may decrease significantly within the first week, the levels may remain elevated above the NIOSH recommended exposure limit for several weeks and return to approximately background levels in about 5-months under "normal ventilation conditions".

3. The dispersion of PCB-bearing particulate and/or condensation of volatilized PCB vapors may result in contamination of both high- and low-skin contact surfaces above comparative background. In this survey, after 34 days the resultant contamination was significantly higher on low- versus high-skin contact surfaces.

4. Based on the low level of potential exposure and the low acute toxicity of PCBs, a significant human health risk is not likely to be associated with being in a room for a short period of time after electrical burnout of a pre-1978 fluorescent light ballast. However, to prevent continued respiratory and dermal exposure to PCB, the rooms should be ventilated and localized cleanup of high-skin contact surfaces completed. NIOSH considers PCBs to be potential human carcinogens, thus, recommends the systematic removal of all PCB-containing ballast.

5. In both the Blaine and Seward Schools the PCB concentrations on high skin contact surfaces were generally non-detected. The concentrations on elevated horizontal surfaces, in some instances, exceeded the guideline of 1 ug/100 cm^2 used by NIOSH investigators in assessing PCB building contamination. Since there

is low potential for direct skin contact with these surfaces, the contamination is not believed to represent an immediate health risk to students or faculty. The absence of measurable airborne concentrations suggest that resuspension of this material is minor.

VIII. RECOMMENDATIONS

1. Subsequent to a recommendation from the NIOSH investigator in July 1985, the elevated horizontal surfaces at the Catherine Blaine School that showed concentrations exceeding 0.75 ug/100 cm^2 were cleaned [14]. These surfaces were first vacuumed with a vacuum equipment with a high efficiency particulate air (HEPA) filter, then washed with a detergent solution containing a non-ionic surfactant and trisodium phosphate.

2. When a PCB-containing ballast fails, proper procedures should be followed to minimize the potential exposure to PCBs via inhalation, dermal absorption or ingestion. Proper procedures following burnout of a ballast would be (a) turn off the light fixture and remove persons from the room as soon as possible; (b) open the windows in the room and take any measures possible to vent room air directly to the outdoors and replace it with fresh air; (c) remove the failed ballast; (d) clean up any asphalt-residue that may have leaked from the ballast; and (e) wipe down the top surfaces of general contact surfaces (such as desks, chairs, tables, etc.).

   Persons doing the cleanup or equipment removal should wear protective gloves to prevent skin contact with the PCBs. (PCBs are readily absorbed through the skin). Gloves made of nitrile or neoprene rubber are suitable for this type of exposure. If the incident occurs in a room which cannot be vented, the person replacing the failed ballast can reduce his potential inhalation exposure by wearing a one-half facepiece respirator equipped with an organic vapor cartridge and high efficiency particulate air filter.

   The hard, "relatively non-absorbent" type surfaces that are visibly contaminated with residue that has leaked from the ballast should be cleaned with an organic solvent such as deodorized kerosene or mineral spirits. To avoid spreading the contamination to a larger area by wiping it with the solvent, the bulk of the residue first should be removed with a spatula or paper towel. It is important to note that the residue may be concentrated with percent levels of PCBs. Thus, care should be taken to avoid skin contact.

Absorbent types of materials (e.g., carpets) visibly contaminated with residue that has leaked from the ballast cannot be cleaned easily. In the case of carpeting the material should be removed in a six-inch radius around the contamination point.

General surface cleaning should be done using a solution of a octylphenoxypolyethoxyethanol nonionic surfactant detergent in water followed by a water rinse. An application strength of approximately 5% (volume-to-volume) should be adequate to remove the surface contamination. The addition of a mild caustic such as trisodium phosphate to the wash solution will help emulsify any thin grease deposits that are on the surfaces prior to the ballast burnout and will also help lift waxes and some furniture polishes that will otherwise adsorb PCBs from the air.

Environmental testing following ballast burnout should not be necessary, provided that the procedures described above are implemented. The concentration of PCBs in room air will decrease rapidly if the windows can be opened, the room ventilated, and the ballast removed quickly.

Disposal of any PCB waste material, including the defective ballasts, should be done according to state and U.S. Environmental Protection Agency (EPA) regulations. The EPA regulations require that fluorescent light ballasts manufactured since July 1978 containing no PCBs be marked "No PCBs".

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. Risk Manager, Seattle Public Schools
2. NIOSH Denver Region
4. OSHA, Region X

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

Airborne Concentrations of PCBs (Aroclors 1242 and 1260) in Rooms With and Without Fluorescent Lamp Ballast Burnout

Seattle Public Schools
Seattle, Washington

November 19, 1984

Sample Location	Date of Burnout	Sample Period	Sample Volume Liters	ug/m^3 1242	ug/m^3 1260
Blaine: Room 121	10-16-84	0931-1751	97.5	0.82	ND*
Blaine: Room 134	10-16-84	0933-1752	95.1	1.2	ND
Blaine: Room 140	10-16-84	0937-1754	95.8	0.74	ND
Blaine: Room 124	NR**	0919-1750	96.3	ND	ND
Blaine: Main South Corridor, N-end	NR	1022-1850	100	ND	ND
Seward: Room 2	11-19-84	1542-2330	93.7	ND	ND
Seward: Room 2	11-19-84	1542-2331	91.8	ND	ND
Ingraham: Room 113	11-15-84	1111-1921	95.9	ND	ND
Ingraham: Room 121	11-15-84	1028-1855	102	ND	ND
Ingraham: Room 104	NR	1022-1850	100	ND	ND
Bryant: Room 16	11-16-84	1103-1922	95.7	ND	ND
Bryant: Room 20	11-16-84	1109-1916	99.5	ND	ND
Bryant: Room 22	11-16-84	1110-1915	99.6	ND	ND
Bryant: Room 23	11-16-84	1105-1914	86.7	ND	ND

* Denotes none detected at a detection limit of 0.05 ug/sample.
** Denotes that a ballast burnout was not reported at this location.

Table 2

Airborne Concentrations of PCBs (Aroclors 1242 and 1260)

Catherine Blaine Elementary School
Seattle, Washington

March 5, 1985

Sample Location	Sample Period	Sample Volume Liters	ug/m^3 1242	ug/m^3 1260	ug/m^3 Total
Room 104	0833 - 1633	264	ND*	ND	--
Room 121	0828 - 1632	266	ND	ND	--
Room 134**	0820 - 1615	261	0.42	ND	0.42
Room 140	0815 - 1610	261	0.27	ND	0.27
Cafeteria	0840 - 1631	259	ND	ND	--
Central corridor-midpoint	0900 - 1630	247	ND	ND	--
S. Corridor at principal's office	0910 - 1632	243	ND	ND	--

* Denotes none detected at a detection limit of 0.15 ug/m^3.
** Rooms 134 and 140 experienced ballast burn-out on October 16, 1984.

Table 3

Surface Concentrations of PCBs (Aroclors 1242 and 1260)

Ingraham School
Seattle, Washington

November 19, 1984

Sample No.	Sample Location	Aroclor 1242	Aroclor 1260
046	Admin. office: work counter	ND*	ND
047	Admin. office: top storage cabinet	ND	ND
048	Room 104: file cabinet	ND	ND
049	Room 113: top ledge classroom sepera.	ND	ND
050	Room 113: students desk	ND	ND
051	Room 121: top ledge bulletin board	ND	ND
052	Room 121: students desk	ND	ND
053	Room 110: top ledge bulletin board	ND	ND
054	Room 110: students desk	ND	ND

* Denotes none detected at a limit of detection of <0.10 ug/100 cm^2

Table 4

Surface Concentrations of PCBs (Aroclors 1242 and 1260)

Bryant School
Seattle, Washington

November 19, 1984

Sample No.	Sample Location	Aroclor 1242	Aroclor 1260
055	Room 15: students desk	ND*	ND
056	Room 15: top surface wall clock	ND	ND
057	Room 16: supply air vent. duct	ND	ND
058	Room 23: top book shelf	ND	ND
059	Room 23: surface vent. duct	ND	ND
060	Room 20: students desk	ND	ND
061	Room 22: surface vent. duct	ND	ND
062	Room 22: students desk	ND	ND
063	Room 26: surface vent. duct	ND	ND
064	Room 26: students desk	ND	ND

* Denotes none detected at a detection limit of <0.10 ug/100 cm^2

Table 5

Surface Concentrations of PCBs (Aroclors 1242 and 1260)

Seward School
Seattle, Washington

November 19, 1984

Sample No.	Sample Location	ug/100 cm² Aroclor 1242	ug/100 cm² Aroclor 1260
039	Room 2: students desk	ND*	ND*
040	Room 2: students desk	ND	ND
041	Room 2: fire sprinkler pipe	ND	1.
042	Room 3: students desk	ND	ND
043	Room 3: top ventilation duct	ND	3.1
044	Room 1: students desk	ND	ND
045	Room 1: top ventilation duct	ND	1.9

* Denotes none detected at a detection limit of <0.10 ug/100 cm²

Table 6

Surface Concentrations of PCBs (Aroclors 1242 and 1260)

Catherine Blaine School
Seattle, Washington

November 19, 1984

Sample Number	Sample Location	PCBs - ug/100 cm^2 1242	1260	Total
011	Room 121: ceiling level window ledge, E-end	ND*	0.58	0.58
012	Room 121: ceiling level window ledge, center	1.4	1.0	2.4
013	Room 121: floor level window ledge, E-wall	ND	ND	ND
014	Room 121: E-wall, height approximately 5-ft	0.13	ND	0.13
015	Room 121: students desk	0.19	ND	0.19
023	Room 134: ceiling level window ledge	2.1	ND	2.1
024	Room 134: ceiling level window ledge	2.0	ND	2.0
025	Room 134: top of refrigerator	0.66	ND	0.66
026	Room 134: students table	0.13	ND	0.13
030	Room 140: top of fan housing, NW-corner	ND	ND	ND
031	Room 140: floor level window ledge, N-wall	0.46	ND	0.46
032	Room 140: beam ledge 2-ft W incident lite	ND	0.27	0.27
033	Room 140: beam ledge S corner	ND	0.74	0.74
034	Room 140: students desk	ND	ND	ND
035	Room 140: desk under incident lite	ND	ND	ND
036	Room 140: students desk	ND	ND	ND
007	Room 119: ceiling level window ledge	ND*	1.2	1.2
008	Room 119: students desk	ND	ND	ND
009	Room 122: ceiling level window ledge	0.60	0.55	1.15
010	Room 122: students desk	ND	ND	ND
001	Room 124: ceiling joist, N-end	ND	0.25	0.25
002	Room 124: file cabinet	ND	ND	ND
003	Room 124: ceiling level window ledge, S-end	ND	0.25	0.25
004	Room 124: students table	ND	ND	ND
021	Room 130: ceiling level window ledge	ND	ND	ND
022	Room 130: students desk	ND	ND	ND
028	Room 136: ceiling level window ledge	0.44	ND	0.44
029	Room 136: students desk	ND	ND	ND
037	Room 137: ceiling level window ledge	ND	ND	ND
038	Room 137: students desk	ND	ND	ND

* Denotes none detected at a detection limit of <0.10 ug/100 cm^2.

Table 6 (continued)

Surface Concentrations of PCBs (Aroclors 1242 and 1260)

Catherine Blaine School
Seattle, Washington

November 19, 1984

Sample Number	Sample Location	PCBs - ug/100 cm^2		
		1242	1260	Total
018	Room 141: ceiling level window ledge	ND	ND	ND
019	Room 141: students desk	ND	ND	ND
016	Room 143: wall clock	ND	0.25	0.25
017	Room 144: work counter	ND	ND	ND
005	Main S-corridor, N-end: ceiling level window ledge	ND	32	32
006	Main S-corridor, S-end: top fire extinguisher	ND	2.0	2.0
027	Main N-corridor, N-end: top fire extinguisher	ND	1.6	1.6
020	Main N-corridor, N-end: ceiling level window ledge	ND	20	20

* Denotes none detected at a detection limit of <0.10 ug/100 cm^2.

Table 7

Surface Levels (ug/100 cm^2) of PCB (Aroclors 1242 and 1260)
In Rooms With and Without Burnout

Catherine Blaine School
Seattle, Washington

November 15-20, 1987

Type of Room	n/N	Range	Mean ± 1SD
With Burnout	10/16	<0.10 - 2.4	0.57 ± 0.82
Without Burnout	6/18	<0.10 - 1.2	0.23 ± 0.36

Table 8

Surface Levels (ug/100 cm^2) of PCB (Aroclors 1242 and 1260) On High Skin Contact and Elevated Horizontal Surfaces

Catherine Blaine School
Seattle, Washington

November 19-20, 1984

Type of Room	High Skin Contact			Elevated Horizontal		
	n/N	Range	Mean	n/N	Range	Mean
With Burnout	5/9	<0.10 - 0.66	0.20	6/7	<0.10 - 2.4	1.2
Without Burnout	0/9	<0.10	--	6/11	<0.10 - 1.2	0.34

Table 9

Surface Concentrations of PCBs (Aroclors 1242 and 1260)

Catherine Blaine Elementary School
Seattle, Washington

March 5, 1985

Sample Location	PCBs - ug/100 cm^2		
	1242	1260	Total
E-W corridor: saw-tooth window ledge, N-wall	ND*	17	17
N corridor at Room 133: saw-tooth window ledge	ND	20	20
N corridor at Room 126: saw-tooth window ledge	ND	21	21
S corridor at Room 103: saw-tooth window ledge	ND	15	15
Room 104: closet doors, ledge of frame	ND	0.38	0.38
Room 104: table at S-quad	ND	ND	ND
Cafeteria: curtain cornice E-wall	ND	2.3	2.3
Cafeteria: W-quad on table	ND	ND	ND
Room 138: saw-tooth window ledge	0.31	0.40	0.71
Room 138: NE-quad on desk	ND	ND	ND
Room 139: saw-tooth window ledge	ND	0.62	0.62
Room 139: SW-quad on desk	ND	ND	ND
Room 135: saw-tooth window ledge	ND	0.15	0.15
Room 135: center of desk	ND	ND	ND
Room 133: saw-tooth window ledge	ND	ND	ND
Room 133: NE-quad on desk	ND	ND	ND
Room 118: saw-tooth window ledge	0.74	1.2	1.94
Room 118: SE-quad on desk	ND	ND	ND
Room 120: saw-tooth window ledge	0.31	0.65	0.96
Room 120: NW-quad on desk	ANC**	ANC**	-
Room 125: saw-tooth window ledge	0.18	0.30	0.48
Room 125: center on desk	ND	0.06	0.06
Room 148: saw-tooth window ledge	0.41	ND	0.41
Room 148: center on desk	ND	ND	ND
Room 127: saw-tooth window ledge	0.45	0.45	0.90
Room 127: SW-quad on desk	ND	ND	ND
Air handling unit for Room 143	0.35	1.8	2.15
Air handling unit for cafeteria	ND	1.4	1.4
Boiler room: pipe at W-wall	ND	ND	ND
Transformer vault: floor at E-wall	ND	0.07	0.07
Transformer vault: W-wall	ND	ND	ND

* Denotes none detected at a detection limit of 0.05 ug/100 cm^2
** Analysis not completed due to presence of interfering peaks.

Table 10

Surface Concentrations of PCBs (Aroclors 1242 and 1260)

Seward Elementary School
Seattle, Washington

March 6, 1985

Sample Location	PCBs - ug/100 cm^2		
	1242	1260	Total
Building A: pipe 1st floor corridor, center	ND*	9.1	9.1
Building A: cable at S-end 1st floor corridor	ND	ND	–
Building A: pipe 2nd floor corridor, N-end	ND	3.2	3.2
Building A: wall 2nd floor corridor, S-end	ND	ND	–
Building A: room 6 TV SE-quad	ND	1.9	1.9
Building A: room 6 desk NW-quad	ND	ND	–
Building A: room 8 pipe NW-quad	ANC**	ANC	–
Building A: room 8 desk at center	ND	ND	–
Building A: room 7 supply air vent, N-wall	ND	1.8	1.8
Building A: room 7 desk at center	0.44	0.27	0.71
Building B: pipe 1st floor corridor, center	ND	ND	–
Building B: desk 1st floor corridor, N-end	ND	ND	–
Building B: room 11 map rack, S-wall	ND	ND	–
Building B: room 11 desk at center	ND	ND	–
Building B: room 10 clock, E-wall	ND	ND	–
Building B: room 10 desk at center	ND	ND	–
Building B: room 9, E-wall	ND	ND	–
Building B: room 9, desk at center	ANC	ANC	–
Building B: pipe 2nd floor corridor, center	ND	ND	–
Building B: wall 2nd floor corridor, E-wall	ND	ND	–
Building B: room 15 clock, E-wall	ANC	ANC	–
Building B: room 15 desk at center	ND	ND	–
Building B: room 16 clock, E-wall	ND	ND	–
Building B: room 16 desk at center	ND	ND	–
Building B: room 13 clock, E-wall	0.40	0.40	0.40
Building B: room 13 desk at center	ND	ND	–

* Denotes none detected at a detection limit of 0.05 ug/100 cm^2
** Analysis not completed due to presence of interfering peaks.

Table 11

Concentrations of PCBs on High Skin Contact and Elevated Horizontal Surfaces in the Catherine Blaine and Seward Schools

Seattle, Washington

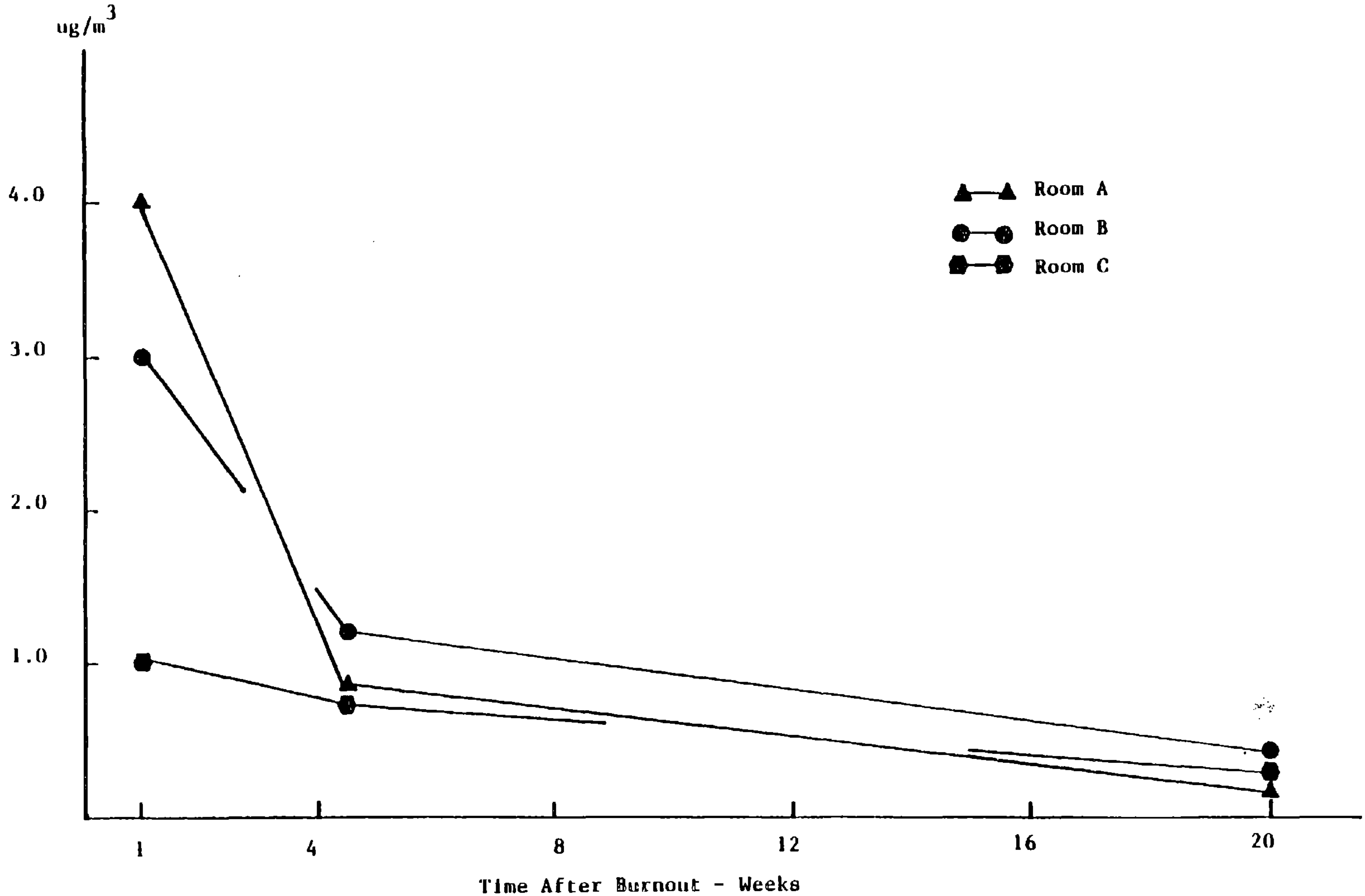
November 19-20, 1984 and March 3-5, 1985

School	Concentration of PCB ug/100 cm^2					
	High Skin Contact			Elevated Horizontal		
	n/N	Range	Mean	n/N	Range	Mean
Blaine	7/29	<0.05 - 0.66	0.09	30/34	<0.05 - 32	4.4
Seward	1/15	<0.05 - 0.71	-	8/15	<0.05 - 9.1	1.5

FIGURE 1

LEVELS OF PCB IN AIR

AFTER FLUORESCENT LIGHT BALLAST BURNOUT



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