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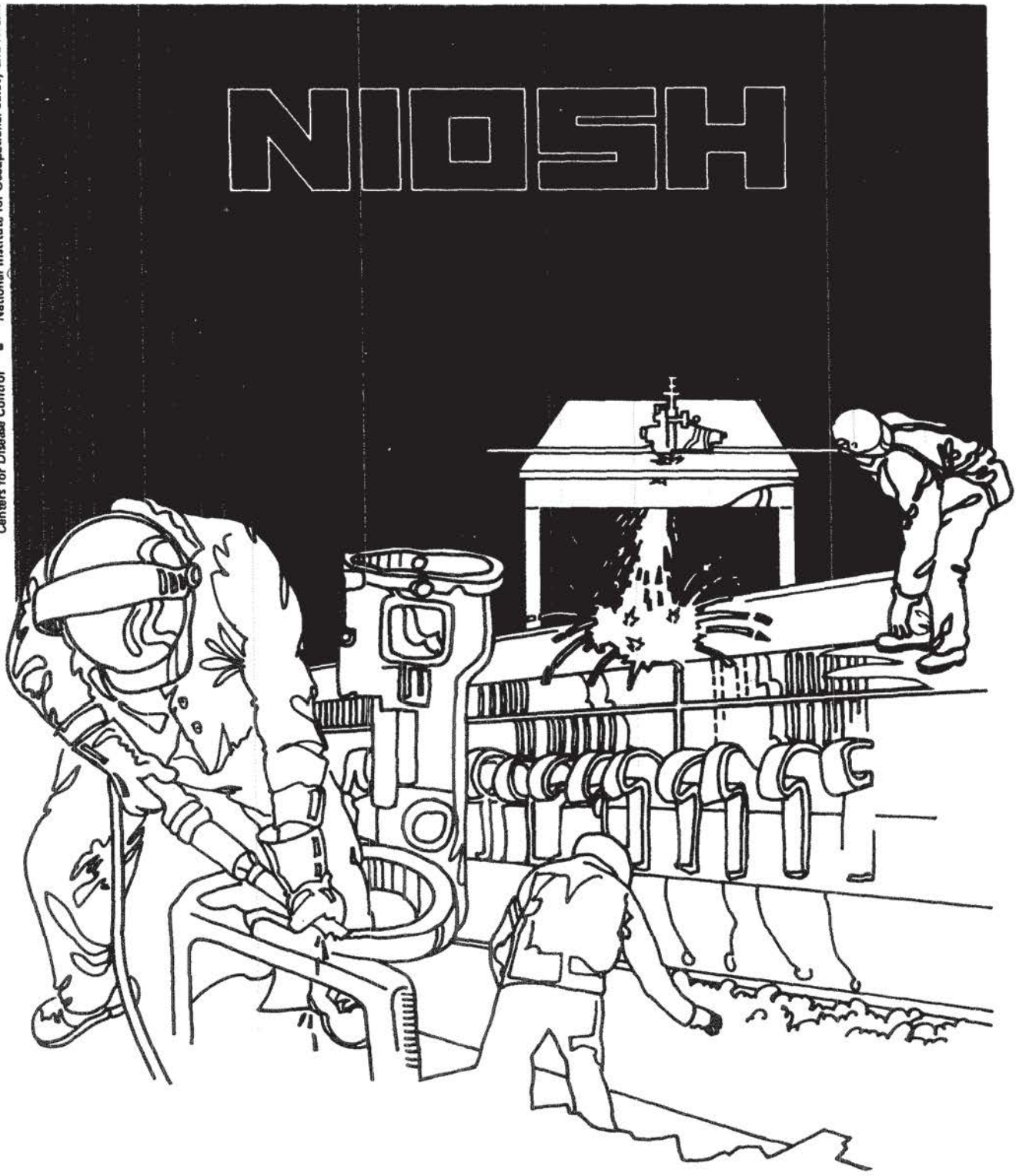

Health Hazard Evaluation Report

HETA 81-046-1144
LONG ISLAND LIGHTING COMPANY
HICKSVILLE, NEW YORK

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.

HETA 81-046-1144
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LONG ISLAND LIGHTING COMPANY
HICKSVILLE, NEW YORK

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I. SUMMARY

In November 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the International Brotherhood of Electrical Workers, Local Union 1049 - an authorized representative of employees of the Long Island Lighting Company (LILCo), Hicksville, New York. The request concerned potential exposure to polychlorinated biphenyls (PCBs) among workers engaged in the maintenance of electrical transformers. The transformers contain mineral oil, as the dielectric fluid, which may be contaminated with PCBs. Other employees are potentially exposed during the storage and subsequent incineration of the waste mineral oil at Long Island Lighting Company power stations.

In January 1981, NIOSH collected bulk samples of the waste mineral oil and wipe samples in the transformer maintenance shops for analysis of PCB contamination. The NIOSH medical officer interviewed and examined the skin of workers in the maintenance shops.

Analysis of seven bulk samples of the mineral oil indicated that Aroclor 1260 was present in all samples, ranging from 17 to 130 parts per million parts of oil. No other Aroclor mixtures of PCBs were detected. Three of 11 wipe samples had Aroclor 1260 present at greater than the limit of detection (0.1 ug/sample). No other PCBs were detected.

Ten of 20 workers were interviewed by NIOSH. None reported having unusual systemic health symptoms, acneiform rashes, or known liver problems. None of seven persons had hyperpigmentation or chloracne on skin examination. Thus no PCB-related health problems were detected during a preliminary screening of the workers.

Considering recent findings published in the literature about the health effects of PCB exposure, NIOSH concludes that the low level exposure of employees to PCBs in the mineral oil does not represent a significant health hazard. The major PCB mixture detected by NIOSH was Aroclor 1260. LILCO should include an analysis for Aroclor 1260 when sampling waste mineral oil for PCB content. Because recent studies have shown a correlation between serum PCB levels and health effects (such as elevated triglycerides, mild liver toxicity, and chloracne), NIOSH recommends that, as a surveillance measure, LILCO should test the workers in the transformer shop for serum PCB levels. Workers with elevated PCB levels should then be medically evaluated as described in the body of the report.

KEYWORDS: SIC 4931 (Electric and Other Utility Services), polychlorinated biphenyls, PCB, Aroclor 1260, chloracne, triglycerides, liver toxicity.

II. INTRODUCTION

In November 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the International Brotherhood of Electrical Workers, Local Union 1049 - an authorized representative of employees of the Long Island Lighting Company, Hicksville, New York. The request concerned potential exposure to polychlorinated biphenyls (PCBs) among workers engaged in the maintenance of electrical transformers. The transformers contain mineral oil, as the dielectric fluid, which may be contaminated with PCBs.

At the time of the request, NIOSH received five bulk samples of waste mineral oil obtained by employees from a tank truck used to transport waste oil from the transformer maintenance shops at the Hicksville Storage Yard Area to the power stations. These samples were analyzed for PCB content.

In January 1981, NIOSH met with representatives of the Long Island Lighting Company and the International Brotherhood of Electrical Workers to tour the transformer maintenance shops in the Hicksville Storage Yard Area. The NIOSH medical officer interviewed some of the workers and examined their skin. On January 23, 1981, NIOSH collected bulk and wipe samples for analysis of PCB contamination. The results of the environmental sampling were verbally conveyed to the Long Island Lighting Company and to the employees in May 1981.

Further NIOSH response to this request has been delayed pending the results of other current investigations into the potential health effects of PCB exposure. This report will present the results of NIOSH environmental sampling and summarize the findings from recent medical investigations.

II. BACKGROUND

PCBs are chemically stable mixtures of chlorinated biphenyls that do not conduct electricity and can withstand long periods of high temperature and pressure. These properties have made them useful in electrical capacitors and transformers. Most capacitors currently in use in the United States contain high levels of PCBs. Some transformers - particularly in locations where the risk of fire must be minimized - contain high levels of PCBs in fluids known as "askarels". Most transformers contain mineral oil, not PCBs, as the dielectric fluid.

However, the Environmental Protection Agency (EPA) has noted that mineral oil used in transformers may be contaminated with PCBs. According to EPA definitions, a transformer with dielectric fluid containing greater than 500 parts per million (ppm) PCBs is a "PCB transformer". (These include the askarel transformers.) Mineral oil with 50 to 500 ppm PCBs is considered to be "PCB contaminated", while oil with less than 50 ppm is considered to not contain PCBs.

The transformers in the Long Island Lighting Company (LILCO) system range in size from Distribution transformers, rated at 25 KVA and containing 30 gallons of dielectric fluid, to Substation transformers, averaging 5000 KVA

and 7000 gallons of fluid. Over 99% of the transformers in the system contain mineral oil as the dielectric fluid. The approximately 25 askarel-containing transformers in the system are labeled and are not routinely handled by the LILCO maintenance shops.

The mineral oil-containing transformers are maintained by 20 workers in three shops. The Pole Top or Recycling Shop repairs small transformers up to 167 KVA. The Intermediate Shop repairs 167 to 1500 KVA transformers. The Substation Shop maintains large transformers over 1500 KVA.

Used mineral oil from the smaller transformers generally is stored in 55 gallon drums for later disposal. The oil in the larger transformers is cleaned, if at all possible, and recycled back into the transformers. Since June 1980, the waste mineral oil has been pooled in a tank truck and subsequently transported to LILCO power stations to be incinerated in generating electricity. Workers at the power stations pump the oil from the truck into storage tanks where it mixes with other oil and is burned.

Before transporting the waste mineral oil, LILCO analyzes a sample of the pooled oil for PCB contamination from each of five compartments in the 9,000 gallon tank truck. As of mid-1981, the method of analysis detected Aroclor 1242 and Aroclor 1252 mixtures of PCBs. Since then, it has been analyzed for a broader spectrum of PCBs. If the oil contains less than 50 ppm PCBs, it is transported to the power stations and incinerated. If the oil contains 50 to 500 ppm PCBs, it is stored by LILCO for proper disposal as a PCB-contaminated fluid.

The oil in the large transformers generally is analyzed for PCBs before employees work on the transformers. Because of the cost and technical difficulty of analysis, LILCO does not routinely analyze the oil from the smaller transformers until the drums of oil have been pooled in the tank truck prior to disposal.

Workers in the transformer maintenance shops do not wear special protective clothing while working with the mineral oil. "PCB kits" of protective clothing are available for use in cleaning up spills from capacitors and askarel-containing transformers.

After shipments of the waste mineral oil to the power stations began in June 1980, employees at the Glenwood Power Station became concerned that they potentially may be exposed to PCBs. They requested that NIOSH analyze samples of the waste oil. In addition, the Union requested that NIOSH evaluate potential PCB exposure among the maintenance shop workers.

III. EVALUATION CRITERIA

Data obtained from animal experimentation suggest that the acute toxicity of PCBs is low(1-3). Animal toxicity studies, however, have shown that PCBs may decrease immunity and increase susceptibility to infection, are carcinogenic in rodents, and impair fertilization in female rodents and rhesus monkeys(1-5).

The toxicity of PCBs depends on the number and locations of the chlorines in the PCB molecule and on the duration of exposure. Absorption is primarily through the skin or gastrointestinal tract, but inhalation can be an important route of absorption if the PCBs are heated or if one is exposed to PCBs in a confined space. The NIOSH recommended standard for occupational exposure to PCBs is a time-weighted average (TWA) of 1.0 micrograms total PCBs per cubic meter of air, for up to a 10-hour workday, 40 hour workweek(3).

Knowledge of human toxicity is limited and has been gathered largely from workers chronically exposed (1) or populations accidentially exposed to massive amounts of PCBs (the Yusho incident in Japan) (6).

PCBs have been demonstrated to have the following toxic effects in humans:

1. Eye, nose, and throat irritation on direct contact
2. Gastrointestinal disturbances
3. Chloracne: a persistent skin eruption, similar to acne but more severe and with a different distribution on the body
4. Skin rashes, thickening, and hyperpigmentation
5. Swelling of the miebomian glands in the upper eyelid
6. Mild liver toxicity, which may be manifested as fatigue, abdominal pain, nausea, vomiting, loss of appetite, jaundice, and edema
7. Abnormalities in offspring of women heavily exposed

While mixtures of PCBs tested in mice and rats have consistently been shown to induce liver tumors, no study has been performed which adequately addresses the question of carcinogenicity of PCBs in humans. Materials which have been demonstrated to cause cancer in animals should, however, be treated as potential human carcinogens, and it would be judicious to limit exposure to those materials to the lowest feasible level.

Dietary PCB exposure, the major source of population exposure, occurs primarily through eating fish, but PCB residues are also found in milk, egg cheese, and meat. It has been estimated that the average daily dietary intake of PCBs does not exceed 10 micrograms(7). Although there are no widely accepted normal values for serum PCB concentrations, previously published studies have demonstrated that PCBs can be found in the serum of most non-occupationally exposed persons. Such studies have reported serum PCB values ranging from 0 to 42 parts per billion (ppb), with mean concentrations ranging from 2.1 to 24.4 ppb(8). In the largest study involving 616 individuals, the range of serum PCBs was 0 to 29 ppb(9). Based on these findings in a group without unusual exposure to PCBs, a reasonable acceptable upper limit value for serum PCB would appear to be around 30 ppb. This value would be influenced by specific home location and dietary habits (eating a lot of fish), and may vary by the testing laboratory.

Higher PCB serum levels have been found among occupationally exposed groups. Most of these studies have been conducted on workers engaged in the manufacturing of capacitors with high levels of PCBs (and also usually trichlorobenzene). Fischbein et al. evaluated 326 capacitor manufacturing workers exposed to various mixtures of PCBs(10). The mean plasma concentrations were 124 ± 229 ppb for "lower PCB homologues" and 48 ± 85 ppb for "higher PCB homologues"(sic). Plasma levels increased with increasing reported exposures. The exposed workers reported high levels of symptoms, including respiratory irritation, dermatitis, gastrointestinal disturbance, and various neurologic symptoms. Forty percent had abnormalities of the skin such as erythema, dryness, or thickening. Only 5% had acneiform eruptions. Overall there was low prevalence of abnormal laboratory findings, but elevated plasma PCB levels were associated with elevated serum glutamic oxaloacetic transaminase (SGOT) levels - one chemical marker of liver toxicity. The interpretation of the findings is limited, however, because no non-exposed worker control groups were included in the study.

Baker et al. measured PCB serum levels in populations with and without occupational exposure in Bloomington, Indiana(11). The workers with occupational exposure worked in a capacitor manufacturing plant which principally used Aroclor 1016 and Aroclor 1242. The following total serum PCB levels were found:

	Number	Mean serum total PCB (ppb)
Workers with exposure	18	75.1
Workers' families	19	33.6
Community controls	22	24.4

No chloracne or other symptomatic manifestations of toxicity were found, nor were significant correlations found between PCB levels and tests of hematologic, hepatic, or renal function. Plasma triglyceride levels increased significantly with serum PCB concentrations in both alcohol drinkers and nondrinkers. The authors concluded that PCB may alter lipid metabolism at levels of exposure and bioaccumulation insufficient to produce overt symptoms.

Maroni et al. reported results of PCB measurements done on whole blood of 80 capacitor manufacturing workers exposed for many years to PCB mixtures in a plant in Italy(12). They reported that mean PCB recovery from serum is approximately 60% of the recovery from whole blood. Their results were as follows:

	Number	Mean blood PCBs (ppb)	Range
Currently exposed workers	60	377 ± 258	88-1319
Past exposed workers	17	292 ± 161	94-631
Workers with other occ. exposure	3	110 ± 31	88-146

Fifteen of the 80 workers were found to have skin diseases, including four with chloracne(13). Sixteen had some evidence of hepatic toxicity, as indicated by increases in one or more liver enzymes. The abnormalities in the liver enzymes did not follow a consistent pattern among the exposed workers.

It is important to note that these three studies concerned workers engaged in the manufacturing of capacitors. In each study, the workers generally had chronic exposures to fluids containing high levels of PCBs. The mean serum PCB levels ranged from 75 to 226 (60% of 377 measured in whole blood) ppb in exposed workers. The medical findings were inconsistent between the studies, but overall they indicated that exposed workers had dermatologic changes, elevations in serum triglycerides, and laboratory evidence of mild liver toxicity. No particular biochemical test was specifically associated with PCB exposure.

More recently, Chase et al. evaluated 120 workers potentially exposed to PCB-containing transformer fluids(14). The average plasma PCB levels of 86 exposed workers was 33.4 ppb (range: 10-312). This level is considerably below the levels found in the capacitor manufacturing workers. In the exposed group, significant correlations were found between plasma PCB and serum triglyceride and SGOT levels. Transient symptoms of skin and irritation were reported, but no acneiform lesions were observed. These findings suggest that bioaccumulation of PCBs is substantially lower among workers exposed to PCB-containing transformers than to capacitors. Nevertheless, biochemical evidence of potential health effects was still observed. As in the above studies, bichemical effects were associated with increasing serum levels of PCBs among the exposed workers.

IV. EVALUATION DESIGN AND METHODS

In November 1980, NIOSH received five bulk samples of waste oil taken from each compartment of the tank truck used to transport waste mineral oil from the Hicksville Storage Yard Area to the Glenwood Power Station.

The five samples were analyzed for Aroclors 1016, 1242, 1248, 1254, and 1260. The samples were diluted in hexane and rinsed on a florisil column. The volume of the eluate was reduced on a rotary evaporator and analyzed on a gas chromatograph using an electron capture detector. The presence of the Aroclors was determined by comparing the chromatogram patterns of each sample with those obtained from EPA Standard Aroclors. The limit of detection was 1 ug/g (ppm) for each Aroclor mixture.

On January 23, 1981, NIOSH conducted environmental sampling for PCBs in the transformer maintenance area of the Hicksville Storage Yard Area. Two bulk samples were obtained - one was a pooled sample from eight Distributor transformers and the other was a sample of oil obtained from the large transformer shop. These bulk samples were analyzed as described above.

Eleven wipe samples using AA filters were obtained in various locations in the transformer maintenance shops. Each filter was washed in a vial with toluene. The aliquots were analyzed on a gas chromatograph using an electron capture detector. Again the presence of the the Aroclors was verified by comparing the chromatogram patterns of each sample with known EPA standards.

V. RESULTS AND DISCUSSION

A. Environmental

The results of the analysis of the five bulk samples reportedly obtained from the tank truck are shown in Table 1. The Aroclor 1260 content of the five samples ranged from 17 to 57 ppm, while all the other Aroclors (1016, 1242, 1248, and 1254) were below 10 ppm in each sample. These results indicate that Aroclor 1260 is the greatest PCB contaminant in the waste mineral oil. This finding is significant in that LILCO at the time of the sampling was measuring only for Aroclor 1242 and Aroclor 1254. LILCO now also samples for Aroclor 1260. Given statistical and analytical variance, one cannot conclude that the PCB content of the waste oil was definitely above the EPA limit of 50 ppm.

While levels specifically above or below the 50 ppm are relevant to EPA regulations concerning the incineration of PCB-containing fluids, it is unlikely that small differences in the concentration of PCBs at these general levels would cause any material difference in health effects. Given the low levels of PCBs found in the waste oil, NIOSH believes that there is no significant health hazard to workers at the LILCO power stations in pumping the waste oil into the storage tanks for subsequent incineration.

The two bulk samples obtained in the transformer maintenance shops were also analyzed for PCB content. Again in both samples Aroclor 1260 was detected in higher levels than the other Aroclors. For the pooled sample from eight Distributor transformers, Aroclor 1260 was present at 130 ppm. For the sample from the large transformer shop, it was present at 24 ppm. In both samples, the other Aroclors were each present below 1 ppm.

The results of the analysis of the wipe samples are shown in Table 2. Aroclor 1260 was detected above 1 ug/sample (the lower limit of detection) on three samples - on a network transformer in the Intermediate shop, on a trap in the Large Transformer shop, and on the controls and piping of the tank truck. All other Aroclors on these samples and other other samples were negative.

The results of the sampling in the maintenance shops again indicate that the major potential PCB contaminant is a PCB mixture equivalent to Aroclor 1260. While levels were generally low and well within EPA established limits, the results indicate that there is PCB contamination of at least some of the Distributor transformer fluid and that PCB contamination occurs on surfaces throughout the transformer maintenance area.

B. Medical

In January 1981, the NIOSH medical officer toured the transformer maintenance areas and interviewed one-half of the 20 workers. The average time working in the area was 10 years. None remembered ever working on an askarel-containing transformer or being otherwise exposed to PCBs. None reported having unusual systemic health symptoms, acneiform rashes,

folliculitis, or known liver problems. Seven persons had skin examinations: none had chloracne or hyperpigmentation. Thus no PBC-related health problems were identified during a preliminary screening of the workers.

Considering the recent findings reviewed above about the health effects of PCB exposure, we believe that further NIOSH medical testing of the workers in the transformer maintenance shops is not indicated at this time. The relatively minor health effects reported elsewhere were observed only among workers with substantially greater exposure to PCBs than that of the LILCO employees. However, since plasma PCB levels have been correlated with health effects, NIOSH believes that it would be worthwhile as a surveillance measure for LILCO to test the workers in the transformer maintenance shops for PCB levels. Only workers with elevated PCB levels would then need to be medically tested.

VI. CONCLUSIONS AND RECOMMENDATIONS

Aroclor 1260 was found at low levels in both bulk and wipe samples tested by NIOSH. This PCB mixture is likely the major potential PCB contaminant of the transformer mineral oil used by LILCO. Testing of waste mineral oil should specifically include analysis of Aroclor 1260 as the most likely potential PCB contaminant.

Low levels of PCB contamination were found in bulk samples of the mineral oil and on wipe samples collected in various areas in the transformer maintenance shops. These low levels of PCBs likely do not represent a significant health hazard. Because PCBs are considered potential human carcinogens, unnecessary exposure to any amount of PCBs should be minimized. Employees should wash their hands before eating or smoking. Working surfaces in the shops should be kept clean and free of mineral oil to the extent feasible.

The low concentration of PCBs in the waste mineral oil taken to the LILCO power stations for incineration is not likely to present a health hazard to the power station workers.

LILCO should screen the employees in the transformer maintenance shops for serum PCB levels. It should be noted that LILCO recently screened many of its employees for PCB levels. The screening indicated that employees generally do not have elevated PCB levels. The serum PCB levels of the transformer maintenance shop workers could be compared to levels found among other LILCO employees. Workers with elevated PCB levels should then be medically tested, including a physical examination for skin rashes and blood tests for triglycerides and liver function.

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VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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IX. DISTRIBUTION AND AVAILABLILTY OF REPORT

For the purposes of informing the "affected employees", copies of this report should be posted in a prominent place(s) near where the employees work.

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Copies of this report have been sent to:

Long Island Lighting Company
International Brotherhood of Electrical Workers, Local Union 1049
U.S. Department of Labor, Occupational Safety and Health Adminsitration, Region II
U.S. Department of Health and Human Services, Public Health Service, NIOSH, Region II
New York State Department of Health

TABLE 1

ANALYSIS OF BULK SAMPLES FOR PCB CONTAMINATION
OBTAINED FROM TANK TRUCK, NOVEMBER 1980

LONG ISLAND LIGHTING COMPANY, HICKSVILLE, NEW YORK

Sample Number	PCB Content in ug/g (ppm) by Aroclor Type 1016	1242	1248	1254	1260
1	10*	10*	10*	10*	17
2	10*	10*	10*	10*	17
3	10*	10*	10*	10*	52
4	10*	10*	10*	10*	56
5	10*	10*	10*	10*	57
Lower Limit of Detection	1	1	1	1	1

* Limits of detection vary because of sample dilution and interference of the major Aroclor found.

TABLE 2

ANALYSIS OF AA FILTER WIPE SAMPLES FOR PCB CONTAMINATION
TRANSFORMER MAINTENANCE SHOPS

LONG ISLAND LIGHTING COMPANY, HICKSVILLE, NEW YORK

Sample Location	PCB Content in ug/sample by Aroclor Type 1016	1242	1248	1254	1260
PCB storage area, #24 drum	0.1*	0.1	0.1	0.1	0.1
PCB storage area, #10 drum	0.1	0.1	0.1	0.1	0.1
Counter area, Pole Top Shop	0.1	0.1	0.1	0.1	0.1
Test Console, Pole Top Shop	0.1	0.1	0.1	0.1	0.1
Storage Desk, Capacitor Tanks	0.1	0.1	0.1	0.1	0.1
Barrel, Open Platform	0.1	0.1	0.1	0.1	0.1
Network Transformer, Intermediate Shop	0.1	0.1	0.1	0.1	18.0
Test Console, Intermediate Shop	0.1	0.1	0.1	0.1	0.1
Trap in Large Transformer Shop	0.1	0.1	0.1	0.1	1.6
Controls and Piping of Tanker #79	0.1	0.1	0.1	0.1	13.0
Waste oil, Loading Platform	4.0**	4.0	4.0	4.0	4.0

* The lower limit of detection is 0.1 ug/sample for each Aroclor.

** The lower limit of detection for this sample is higher because of interfering peaks.

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