AN INVESTIGATION OF THE HEALTH STATUS OF WORKERS WITH POTENTIAL PCB EXPOSURE FROM HUDSON RIVER SEDIMENTS

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Summary

The Department of Health was requested by the Department of Transportation to assist in the evaluation of the health status of a group of DOT workers who had potential exposure to polychlorinated biphenyls (PCBs) in the 1970's. Eventually, five groups of workers were determined to have worked at Hudson River sites of concern, or to have had contact with these sediments in the laboratory.

A questionnaire, designed to determine history of possible PCB exposure and history of specific diseases was distributed to these five cohorts. The numbers of completed questionnaires from employees who had exposure to these sediments were: Department of Transportation field workers from the Albany area, 142; DOT field workers from the Syracuse area, 9; Local 106 of the International Union of Operating Engineers, 20; DOT laboratory workers, 71; and Department of Environmental Conservation field workers, 47 for a total of 289. The purpose of this survey was to identify whether there were any unusual patterns of illness, and if so, whether these patterns were associated with potential PCB exposure. In addition, a list of ten deceased employees was obtained from the five cohorts, and their death certificates were carefully examined for patterns of cancer or other illnesses.

Analyses of the data do not provide evidence of excessive rates of cancer incidence, of unusual patterns of cancer by anatomical site, or of cancer mortality in these five groups. Latency periods, from the year of first PCB exposure to the diagnosis of cancer, were always much shorter than 20 years. Cancer incidence rates were highest in the group with the lowest probable exposure to PCB. Liver disease rates and lung disease rates were low, and not related to PCB exposure.

Although these health studies are reassuring, the period that has elapsed since the mid-1970's does not permit a final evaluation of delayed health effects. Some of the workers had significant potential for skin exposure to the sediments. Therefore, in order to be thorough in assessing the likelihood of developing disease related to Hudson River sediment exposure biological monitoring of the workers with the highest potential for such exposure is recommended. Workers with a history of more than one month exposure to the sediments who were DOT workers from Albany or Syracuse or who were members of the Operating Engineers Union should have their blood levels of PCBs and lead and urinary levels of cadmium determined.

Introduction

In February 1987, Department of Transportation officials received requests for evaluation of the health status of a group of DOT workers who were potentially exposed to toxic chemicals in the 1970's. A group of DOT field staff from the Albany and Syracuse areas had worked on several projects involving construction and dredging of the Hudson River. These included sites in Fort Edward and Moreau in Washington County, and the reconstruction of the Green Island Bridge. Concern arose among DOT employees because of reports that three of their co-workers had died from cancer in the past five years.

DOT asked assistance from the Department of Health in the design, implementation and analysis of a health survey of the employees who worked on these projects, including a follow-up of the reported deaths. This work was performed by Dr. Alice Stark, who is Bureau Director and an environmental epidemiologist, and Dr. Kelley Brix, an occupational physician, in the Bureau of Environmental Epidemiology and Occupational Health.

DOT employees became concerned because of recent information on the toxicity of some of the contaminants in the dredged materials. In particular, these Hudson River sediments have been found to have widely distributed contamination with polychlorinated biphenyls (PCBs). PCBs were formerly extensively used in electrical transformers and capacitors and are very persistent in the environment. In previous studies, humans who were exposed to high levels of PCBs have developed liver disorders and chloracne, a skin disease. In addition, high exposures to PCBs have caused liver tumors in experimental animals, but studies have not linked exposure to PCBs with human cancer. Concern was also expressed that some sediments in the Hudson River were contaminated with heavy metals, such as lead, cadimum, zinc, mercury and chromium.

There were three major Hudson River projects during which workers may have had exposure to sediments. In 1974-75, dredging spoils were removed from the Fort Edward area and were placed in the Moreau landfill. The Department of Environmental Conservation estimates that these sediments contained an average of 90 to 100 ppm PCBs. This area was dredged and landfilled again in 1978. At that time, the average PCB levels were 20 to 25 ppm. Reconstruction of the Green Island Bridge in 1979 involved work around sediments that contained an average of 10 ppm PCBs.

Ultimately, it was determined that there were five potential working groups (cohorts) that worked at these Hudson River sites or who were indirectly exposed to these sediments. These included: (1) DOT field workers from the Albany area; (2) DOT field workers from the Syracuse area; (3) members of Local 106 of the International Union of Operating Engineers; (4) DOT laboratory workers; and (5) Department of Environmental Conservation field workers. Each of these is described further in the Results Section.

A questionnaire, designed to determine possible past exposure to PCBs and history of specific diseases, was distributed to employees of these 5 cohorts. In addition, death certificates were obtained for all the deceased employees, in these 5 groups, who were determined to have worked at the Hudson River sites. The purpose of these two surveys was to identify whether there were any unusual patterns of illness, and if so, whether these patterns were associated with potential PCB exposure.

The Methods Section describes the rationale and implementation of the two surveys. A description of the potential exposure is given for each of the cohorts in the Results Section, as well as a summary of their health complaints. The causes of death for the deceased employees is also summarized in the Results Section. The Conclusions Section ends with an overall summary of the findings and recommendations for further action, including follow-up of some exposed employees.

Methods

Staff from DOT, from the Operating Engineers Union and from DEC compiled a list of all employees known to have worked on the Hudson River sites in the 1970's, including some employees who have transferred to other jobs. In addition, DOT laboratory workers who performed chemical analyses on field samples were identified. A questionnaire was distributed to each of these employees and forwarded to the Department of Health, with provisions for maintenance of confidentiality.

The questionnaire was designed to obtain information on basic demographics, history of potential exposure, and health history. Demographics included name, address, social security number, birthdate, cohort and length of employment. Exposure information included period and duration of potential exposure to PCBs, detailed job description, and use of personal protective equipment. There were health questions on cancer, liver disease and lung disease, including specific diagnosis and year of diagnosis.

PCB exposure was chosen as the main focus of this investigation for several reasons: (1) PCBs are stored in the body for years; therefore, these chemicals are the most likely to cause a prolonged health effect that could be assessed several years later. Moderate exposures to metals like lead or mercury would not cause elevated levels in the body for more than a few months at most. (2) PCBs are very widely distributed in Hudson River sediments, whereas distribution of the other contaminants was patchy and intermittent. (3) Workers were more likely to be aware of potential exposure to PCBs, hence they were more likely to recall this exposure more accurately. (4) The dredged materials that were higher in PCBs were also likelier to be higher in other chemicals; therefore, PCBs could serve as a good overall indicator. (5) The potential for inhalation or ingestion, which are the primary routes of exposures of the heavy metals, was low due to the wet nature of the sediments, which decreased the likelihood of dust formation. The most significant route of exposure was through skin absorption, which is of much greater concern for PCBs than for most heavy metals. (6) If an excessive rate of disease were found in the exposed employees, then further study would be required, in any case, to determine whether the disease cases could be linked with a specific chemical.

Cancer was chosen as one of the specific illnesses because of the three reported deaths in exposed workers, and because PCBs have been linked with tumors in experimental animals. Similarly, liver disease was studied, because high exposures to PCBs have been associated with liver disorders in previous human studies. Lung diseases were included in this investigation, because they are a good indicator of overall health status, and because exposure to PCBs has not been linked to lung diseases in humans or animals. In this sense, lung diseases were selected to serve as a comparison illness for this investigation.

Since the mid-1970's, when most of the Hudson River work was performed, some of the potentially exposed employees have died. A list of deceased employees was obtained for the 5 cohorts; all of the cases that were ascertained to have had potential exposure were investigated through the use of their death

certificates. Cases of deceased employees, who may have had exposure, were identified among the Albany DOT field workers (including the original three that had been reported), the Syracuse DOT field workers, and in the group of Operating Engineers. The death certificates were carefully examined for suggestions of patterns of cancer or other illnesses.

Results

The results of the questionnaires were categorized by the five cohorts separately, and by the year(s) and duration of possible PCB exposure. Each cohort will first be described individually, and then conclusions will be drawn for the whole group.

Tables IA. and IB. summarize the results for the DOT field workers from the Albany area. These workers performed a variety of jobs, including engineer, inspector, surveyor and heavy equipment operator. Some of these workers had significant potential for skin exposure to the sediments, and use of personal protective equipment was intermittent. The period of greatest work activity on the Hudson River sites was in about 1974, with the second greatest activity occurring in about 1979.

The DOT field workers from Albany reported 5 cancer cases, in which the years of latency ranged from 3 to 16. Latency is defined as the length of time from the first exposure to a possible carcinogen to the diagnosis of cancer, and the minimum latency for humans is generally at least 20 years. Two cases of liver problems were reported, at least seven years after exposure. High exposures to PCBs can cause liver disorders, but the liver problems usually develop within weeks to months of first exposure. There were also 6 cases of lung diseases reported in this group.

Tables IIA. and IIB. summarize the results for the DOT field workers from the Syracuse area. Their job descriptions, possibility of PCB exposure, and periods of exposure were very similar to the DOT field workers from the Albany area. These workers reported one liver disease case, that developed 11 years after first exposure. They did not report any cancer or lung disease cases.

Tables IIIA. and IIIB. summarize the results for the International Union of Operating Engineers, Local 106. These employees primarily worked as heavy equipment operators, and most of them worked on Hudson River sites in about 1974 or in about 1979. One cancer case was reported with a possible latency of 7 years. One lung disease case and no liver disease cases were reported.

Tables IVA. and IVB. summarize the results for the DOT laboratory workers. Thirty-four of the 90 workers reported very low or no exposure to PCBs at all. The remaining 56 workers reported occasional to frequent handling of field samples (i.e., soil or water) that originated from the Hudson River sites. Their potential for skin absorption, inhalation or ingestion of PCBs would be markedly lower than field workers, such as heavy equipment operators.

The DOT laboratory workers reported 5 cancer cases, with possible latency periods ranging from 7 to 11 years. There were two lung disease cases and no liver disease cases.

Tables VA. and VB. summarize the results for the Department of Environmental Conservation field workers. These workers primarily worked as inspectors, surveyors, geologists, scientists or technicians who sampled water and soil. Their work tended to require less intense and more infrequent contact with the Hudson River sites than some of the other groups, such as the heavy equipment operators. Sixty five DEC workers submitted questionnaires indicating that they had never worked at the Hudson River sites; therefore, their results were not included. Again, most of the workers reported that their possible exposures occurred in about 1974 or 1979.

The DEC field workers reported one cancer case with 5 years of possible latency. There was one liver disorder, which was diagnosed 11 years after exposure, and 1 lung disease case.

Table VI integrates all the information in Tables IA, IIA and IIIA. These three cohorts were combined in table VI because they shared similar types of job descriptions, although not necessarily of the same duration or in the same year. Out of 171 workers, there were 6 cancer cases (3.5%), 3 liver disease cases (1.7%), and 7 lung disease cases (4.1%).

Table VII is a summary of all the cases in Tables IA, IIA, IIIA, IVA, and VA, in which the worker recalled more than one possible month of PCB exposure. The proportion of workers with disease is categorized into the 5 cohorts and the 3 diseases. In addition, Group VI contains the 3 more highly exposed cohorts (the same groups that were summarized in Table VI). Group VII contains the 2 less highly exposed cohorts.

In Table VII, cancer rates range from 0 to 9%, the highest rate being in a lesser-exposed group, the DOT laboratory workers. In fact, Group VII has a higher overall rate (7.4%) than Group VI (4.5%). Similarly, liver disease rates are very low and range from 0 to 11%. The rates are very low in both Group VI (2.3%) and Group VII (1.2%).

Finally, lung disease rates vary from 0 to 6%, and the rates are very similar between Group VI (4.5%) and Group VII (3.7%). Indeed, the rates of cancer and lung disease are identical in Group VI (4.5%) whereas in Group VII cancer rates (7.4%) exceed lung disease rates (3.7%). The survey requested information on lung disease because it is an important indicator of general health status, but at the same time, it is not known to be associated with PCB exposure.

If PCBs had been the cause of cancer in the exposed workers, one would expect higher cancer rates in the more highly exposed cohorts. This is not the case. On the other hand, the slightly higher rates of lung disease in Group VI compared with Group VII, is probably not due to PCB exposure, but instead may be due to either chance, increased age or differences in lifestyle habits.

Table VIII summarizes the information which was obtained for the deceased workers, who were known to have worked on the Hudson River sites. These ten men came from the Albany DOT field workers, Syracuse DOT field workers or from the Operating Engineers Union. Three of them were the index cases for whom the original concerns had been expressed.

Five of these ten men had died from cancer; further analysis of these cases follows in Table IX. One man died of liver failure and cirrhosis; neither his work history nor his history of alcohol use were available. Three men died of cardio-vascular disease, which is the leading cause of death in adults. Heart disease is not known to be related to PCB exposure, and each of these men had a history of heart disease for many years before their deaths. One of these men also had cancer of the prostate, but his physician did not consider it to be an important contributor to his death. One man died of trauma.

To evaluate whether a group of cancer cases represents a cancer cluster due to a common environmental factor, the data should be examined for several types of patterns. First, in a cluster, there are often several cases of the same type of cancer. Table IX demonstrates, that in this group of 11 cases, there are 10 different types. Second, clusters often contain several cases in whom the onset was in unusually young people. In this group, five cases occurred in people less than 50 years old, but two of these types of cancer (testicular cancer and primary bone cancer) most frequently occur in people under 40. Finally, the latency period, which is the length of time between the first exposure to a carcinogen and the diagnosis of cancer, is usually at least twenty years in humans. In the deceased workers, the latency from 1974 (the likeliest year of first exposure) to year of death ranged from 4 to 12 years. The latency from first exposure recalled by the living workers to their respective year of diagnosis ranged from 3 to 14 years. None of these cases has sufficient latency.

The only pattern that readily appears in these 11 cases is that all but one of the cases was diagnosed between 1981 and 1986. Unfortunately, although it can be a devastating illness, cancer is also a common disease. One-third of Americans will develop cancer in their lives and about 20% of Americans will die from cancer. Perhaps because a close-knit group of co-workers developed the symptoms of cancer over a five-year period, it appeared that a work-related cluster had arisen.

Whenever there is concern that an excessive rate of disease has occurred in an occupational group, one not only should examine the relationship of the disease with possible chemical exposures, but one should also consider possible confounding factors. These could include differences between diseased and disease-free individuals in age, sex, race, other medical illnesses, and lifestyle habits (i.e. diet, smoking, alcohol use). It is possible that differences in these factors, rather than differences in chemical exposures, could account for variations in disease rates.

All of our exposed workers were male, but no information is available on these other factors, except for age. Table X summarizes the average age of each of the 5 cohorts, categorized by disease status and length of exposure. If one compares the diseased workers with the non-diseased workers, disregarding length of exposure, it is apparent that in 4 of the cohorts, the ill workers are older than the well workers. In cohort IV, the ill workers were about the same age as the well workers.

If one compares the workers who were exposed less than one month, with the workers exposed more than one month, disregarding health status, it is apparent that in Cohorts I, III and V, the more highly exposed workers were slightly older than the lower-exposed workers. In cohort IV, lower exposed workers were

older than higher exposed workers. (In cohort II there were no workers with less than one month exposure.) In addition, cohorts I, II, and III, which were the more highly exposed cohorts, were older, on the average than cohorts IV and V, which were less exposed.

To summarize, workers who developed diseases generally were older than workers who were well. In addition, workers who were more highly exposed were slightly older than lesser-exposed workers. It is possible that a larger fraction of diseased workers were found in the higher exposed groups, due to advanced age, rather than due to chemical exposure.

Conclusions and Recommendations

1. A large number of employees from five different groups worked on the Hudson River sites during the 1970's. A very substantial proportion of them were located, contacted, and successfully encouraged to provide details on their exposures and health status.

2. There is no evidence that rates of cancer incidence or cancer mortality were excessive in these five groups. In particular, there were no patterns of similar cancer type, and latency periods were invariably less than 16 years. Notably, cancer incidence rates were highest in the group least likely to have significant PCB exposure, the DOT laboratory workers.

3. Liver disease rates were low in all five groups. All of these cases were diagnosed several years after first PCB exposure, which lessens the likelihood of causality.

4. Lung disease was used as a comparison illness. Rates of lung disease were comparable to rates of cancer, and were not related to the likelihood of PCB exposure.

5. Older workers were more likely to be ill, and older workers were also more likely to report higher exposures. Perhaps higher rates of disease in the more highly exposed subgroups were due, at least in part, to age rather than PCB exposure.

6. Overall, the results of the health questionnaire and death certificate studies are reassuring. Some of the sediments contained as much as 100 ppm PCBs. Note that these levels of PCB exposure are very low compared with occupational exposures in the manufacturing or utility maintenance settings. In addition, they were in a predominantly wet form and bound to organic material. This would decrease dust formation and vaporization and therefore the potential for inhalation. Some employees had significant potential for skin exposure, however, therefore, prudence suggests that the more highly exposed employees should have some biological testing.

   The time period that has elapsed since the mid-1970's does not permit a final evaluation of delayed health effects. To determine if further monitoring of health status is needed, a survey of PCB body burdens of the more highly exposed workers should be considered. The subset of the DOT field workers from Albany and Syracuse and the Operating Engineers, who

were potentially exposed to PCBs for more than one month, should have their blood tested for PCB levels. In addition, blood lead levels and urinary cadmium levels should be measured. An investigation of the current body burdens of the most highly exposed workers would either: 1) establish that their blood levels are low and provide reassurance that they have not had excessive exposure to these chemicals in the past; or 2) establish that their levels are elevated, and provide guidance for future follow-up health studies. The Department of Health could provide guidance in the design, implementation, and interpretation of such a biological monitoring survey.

7. The results of this investigation should be shared with the employees who were included in the survey. This should be performed in conjunction with education on the possible health effects of PCBs and other chemical exposures to which they are likely to be exposed in the future. This might also be an appropriate forum for review of appropriate protection techniques, such as use of engineering controls, safe work practices, and proper use of personal protective equipment.

TABLE IA: DOT FIELD WORKERS (Albany)— POSSIBLE PCB EXPOSURE

Disease	PCB Exposure		First Year of PCB Exposure				
	≤1 Month	>1 Month	Before 1968	1968-72	1973-77	1978-82	1983-87	Unknown
NONE	35	94	13	13	60	20	5	18
CANCER	0	5	0	2	0	2	0	1
LIVER DISEASE	0	2	0	1	1	0	0	0
LUNG DISEASE	1	5	0	1	3	1	0	1
TOTAL	36	106	13	17	64	23	5	20

*Note: 4 workers reported no exposure and no diseases.
(These 4 workers were excluded from Table IA.)

TABLE IB: DOT FIELD WORKERS (Albany) - REPORTED SERIOUS ILLNESSES

Case No.	First PCB Exposure	Disease	Year Diagnosed	Age at Diagnosis	Possible Latency	Current Age
1	1979	Lymphoma	1982	49	3	54
2	1978	Lip and Skin cancer	1982	50	4	55
3	1972	Lymphoma	1986	61	14	62
4	1968	Skin cancer	1984	38	16	42
5	?	Skin cancer	1970	?	?	?
6	1976	Liver problems, prostate, kidneys, chest pain, gout, HTN, etc.	1983-liver	29	7	33
7	"early 1970s"	"Liver function off slightly"	1986	49	4 15	50
8	1979	Asthma & Bronchitis	?	?	?	40
9	1977	spots on X-rays	?	?	?	44
10	1975	Bronchial asthma	1980	60	5	67
11	1973	Spots on lungs & trouble breathing	?	?	?	49
12	1976	Asthma	1978	36	2	45
13	?	Asthma	?	?	?	66

TABLE IIA: DOT FIELD WORKERS (Syracuse)— POSSIBLE PCB EXPOSURE

Disease	PCB Exposure ≤1 Month	PCB Exposure >1 Month	First Year of PCB Exposure Before 1968	1968-72	1973-77	1978-82	1983-87	Unkno
NONE	0	8	0	0	2	6	0	0
CANCER	0	0	0	0	0	0	0	0
LIVER DISEASE	0	1	0	0	1	0	0	0
LUNG DISEASE	0	0	0	0	0	0	0	0
TOTAL	0	9	0	0	3	6	0	0

*Note: 1 worker submitted a questionnaire too incomplete to include.

TABLE IIB: DOT FIELD WORKERS (Syracuse)— REPORTED SERIOUS ILLNESSES

Case No.	First PCB Exposure	Disease	Year Diagnosed	Age at Diagnosis	Possible Latency	Current Age
4	1974	"Liver"	1985	52	11	54

TABLE IIIA: OPERATING ENGINEERS UNION— POSSIBLE PCB EXPOSURE

Disease	PCB Exposure ≤1 Month	PCB Exposure >1 Month	First Year of PCB Exposure Before 1968	1968-72	1973-77	1978-82	1983-87	Unknown
NONE	2	16	0	0	10	6	1	1
CANCER	0	1	0	0	0	1	0	0
LIVER DISEASE	0	0	0	0	0	0	0	0
LUNG DISEASE	0	1	0	0	0	1	0	0
TOTAL	2	18	0	0	10	8	1	1

Note: Two workers never worked at Hudson River Sites, and were excluded.

TABLE IIIB: OPERATING ENGINEERS UNION- REPORTED SERIOUS ILLNESSES

Case No.	First PCB Exposure	Disease	Year Diagnosed	Age at Diagnosis	Possible Latency	Current Age
1	1978	Basal Cell carcinoma	1985	52	7	54
2	1979	Chronic Obstructive Pulmonary Disease	1985	59	6	61

TABLE IVA: DOT LABORATORY WORKERS - POSSIBLE PCB EXPOSURE

Disease	PCB Exposure			First Year of Exposure				
	Zero	≤1 Month	>1 Month	Before 1973	1973-77	1978-82	After 1982	Unkno
NONE	8	15	49	2	31	7	40	2
CANCER	0	0	5	0	4	0	0	
LIVER DISEASE	0	0	0	0	0	0	0	
LUNG DISEASE	0	0	2	0	1	0	0	
TOTAL	8	15	56	2	36	7	0	2

Note: Eleven questionnaires had inadequate exposure information, therefore, they were not included (probably these were very low exposure). All of these reported no diseases.

Total Lab Workers = 11 + 8 + 15 + 56 = 90

TABLE IV8: DOT LABORATORY WORKERS - REPORTED SERIOUS ILLNESSES

Case No.	First PCB Exposure	Disease	Year Diagnosed	Age at Diagnosis	Possible Latency	Current Age
1	1974	Testicular cancer	1981	36	7	42
2	1974	Skin cancer, face	1985	59	11	61
3	1974(?)	Primary bone cancer Mets to lung	1983	35	9(?)	39
4	1975	Skin cancer, face, Neck, upper chest	1986	49	11	50
5	?	Skin cancer, nose	1987	40	?	40
6	?	Emphysema	?	?	?	39
7	1974	Asthma, chronic Bronchitis	?	?	?	48

TABLE VA: DEC FIELD WORKERS — POSSIBLE PCB EXPOSURE

Disease	PCB Exposure* ≤1 Month	PCB Exposure* >1 Month	First Year of PCB Exposure: Before 1968	1968-72	1973-77	1978-82	1983-87	Unknown
NONE	22	22	2	1	15	20	3	3
CANCER	0	1	0	0	0	1	0	0
LIVER DISEASE	0	1	0	0	1	0	0	0
LUNG DISEASE	0	1	0	0	0	1	0	0
TOTAL	22	25	2	1	16	22	3	3

*Note: 65 DEC Workers never worked at any of the Hudson River-related sites, therefore, they were excluded.

TABLE V8: OEC FIELD WORKERS - REPORTED SERIOUS ILLNESSES

Case No	First PCB Exposure	Disease	Year Diagnosed	Age at Diagnosis	Possible Latency	Current Age
1	1979	Bladder Cancer	1984	43	5	46
2	1976	Gilbert's Disease	1987	41	11	41
3	1981	Emphysema	"Before 1985"	?	≤4	59

TABLE VI: POSSIBLE PCB EXPOSURE OF ALL DOT FIELD WORKERS AND OPERATING ENGINEERS UNION
(Combination of Tables IA, IIA, and IIIA)

Disease	PCB Exposure* ≤ 1 Month	PCB Exposure* > 1 Month	First Year of PCB Exposure* Before 1968	1968-72	1973-77	1978-82	1983-87	Unknown
NONE	37	118	13	13	72	32	6	19
CANCER	0	6	0	2	0	3	0	1
LIVER DISEASE	0	3	0	1	2	0	0	0
LUNG DISEASE	1	6	0	1	3	2	0	1
TOTAL	38	133	13	17	77	37	6	21

*(See Notes in Tables IA, IIA, and IIIA)

TABLE VII: PROPORTION OF LIVING WORKERS, WITH GREATER THAN ONE MONTH POTENTIAL EXPOSURE TO PCB, WITH DISEASE

:HORT	CANCER	LIVER DISEASE	LUNG DISEASE
DOT Field Workers (Albany)	5%(5/106)	2%(2/106)	5%(5/106)
DOT Field Workers (Syracuse)	0(0/9)	11%(1/9)	0%(0/9)
:I.Operating Engineers	6%(1/18)	0(0/18)	6%(1/18)
/. DOT Lab Workers	9%(5/56)	0(0/56)	4%(2/56)
DEC Field Workers	4%(1/25)	4%(1/25)	4%(1/25)
Total More Highly Exposed Workers (Groups I, II & III)	4.5%(6/133)	2.3%(3/133)	4.5%(6/133)
:I.Total Less Highly Exposed Workers (Groups IV & V)	7.4%(6/81)	1.2%(1/81)	3.7%(3/81)

TABLE VIII: DECEASED WORKERS — POTENTIALLY EXPOSED TO PCBs

se	First PCB Expos.	Causes of Death	Other Conditions	Year of Diagnosis	Latency to Diagnosis	Year of Death	Latency to Death	Age Dea:
	?	1)L.L.L. Pneumonia 2)Squam-ous Cell Carcinoma of tonsil and tongue	—	?	?	1986	?	48
	?	1)Metastatic Adeno-carcinoma of Cecum.	—	1)1976	?	1978	?	ε
	?	1) Adenocarcinome of duodenum w/mets.	--	1)?1983	?	1984	?	51
	?	1)Arteriosclerotic Cardiovascular Disease with Hyocardial failure 2)Arteriosclerotic card. Dis.	3)COPD 4)Carcinoma of Prostrate 5)Pneumonia	1)1983 2)1958 or before	?	1983	?	72
	?	1)Liver Failure 2)Cirrhosis	--	?	?	1985	?	64
	?	1)Acute Myocardial infarction 2)Arteriosclerotic coronary heart disease	3)History of prev-vious M.I.	1)1984 2)"Chronic"	?	1984	?	61
	1974 or 1979	1)Cardiorespiratory Arrest 2)Metastatic Adeno-carcinoma(etiology unknown)	--	1)1981 2)"years"	1)7 or 2 2) ?	1981	7 or 2	51
	1974 or 1979	1)Cardiac Arrest 2)Coronary Artery occlusion. 3)Coronary Artery Atherosclerosis	--	1)1984 2)1984 3)"years"	1)10 or 5 2)10 or 5 3) ?	1984	10 or 5	55
	1974 or 1979	1)Fractured Spinal cord w/decapitated Head 2)Trauma	3)Multiple fractures 3)1981	1)1981 2)1981	(Not applicable)	1981	(Not applicable)	29
	1972?	1)Cancer of liver (?primary)	2)Diabetes mellitus	1)1986 2) ?	1) 14 2) ?	1986	?14	65

TABLE IX:- SUMMARY OF ALL DECEASED AND LIVING CANCER CASES (Excluding Skin Cancer)

ase #,	Exposure* of Overall Cohort*	Type of Cancer	First PCB Exposure**	Year of Diagnosis	Latency to Diagnosis	Year of Death	Latency to Death	Age at Death o Diagnos
ceased Workers								
1	Higher	Squamous Cell Ca of Tonsil & Tongue	1974(?)	?	?	1986	12	48
2	"	Metastatic Adeno Ca of Cecum	"	1976	2	1978	4	61
3	"	Adeno CA of duodenum with mets.	"	?1983	?9	1984	10	51
4	"	Ca of Prostate	"	?	?	1983	9	72
5	"	Metastatic Adeno Ca(Etiology unkn)	"	"years"	?	1981	7	51
6	"	Ca of Liver (? primary)	"	1986	12	1986	12	65
ving Workers								
1	Higher	Lymphoma	1979	1982	3	—	—	49
3	"	Lymphoma	1972	1986	14	—	—	61
.1	Lower	Testicular Ca	1974	1981	7	—	—	36
.3	"	Primary Bone Ca, Mets to lung	1974(?)	1983	9(?)	—	—	35
1	"	Bladder Ca	1979	1984	5	—	—	43

*Higher exposure cohorts are Albany and Syracuse DOT field workers and Union members. This does <u>not</u> mean that these individuals personally had higher levels of exposure.
**1974 is assumed to be the first year of exposure for the deceased workers.
*Age at death for deceased workers, and age at diagnosis for living workers.

TABLE X: AVERAGE AGE OF WORKERS, CATEGORIZED BY COHORT, DISEASE STATUS AND POSSIBLE LENGTH OF EXPOSURE TO PCB*

COHORT	NO DISEASE ≤ 1 Month	NO DISEASE >1 Month	DISEASE PRESENT >1 Month**
DOT Field Workers (Albany)	45.1 ± 7.2	45.1 ± 8.1	50.8 ± 11.8
DOT Field Workers (Syracuse)	(no workers)	40.3 ± 9.8	54 ± 0(1 worker)
I.Operating Engineers	56.3 ± 15.0	57.0 ± 9.0	57.5 ± 5.0
DOT Lab Workers	47.9 ± 6.4	42.5 ± 8.3	45.6 ± 8.1
DEC Field Workers	42.0 ± 6.5	42.3 ± 6.9	48.7 ± 8.3

*Mean Age in Years (1987) ± Standard Daviation

**Because there was only one diseased worker who was exposed less than 1 month, this column was omitted.