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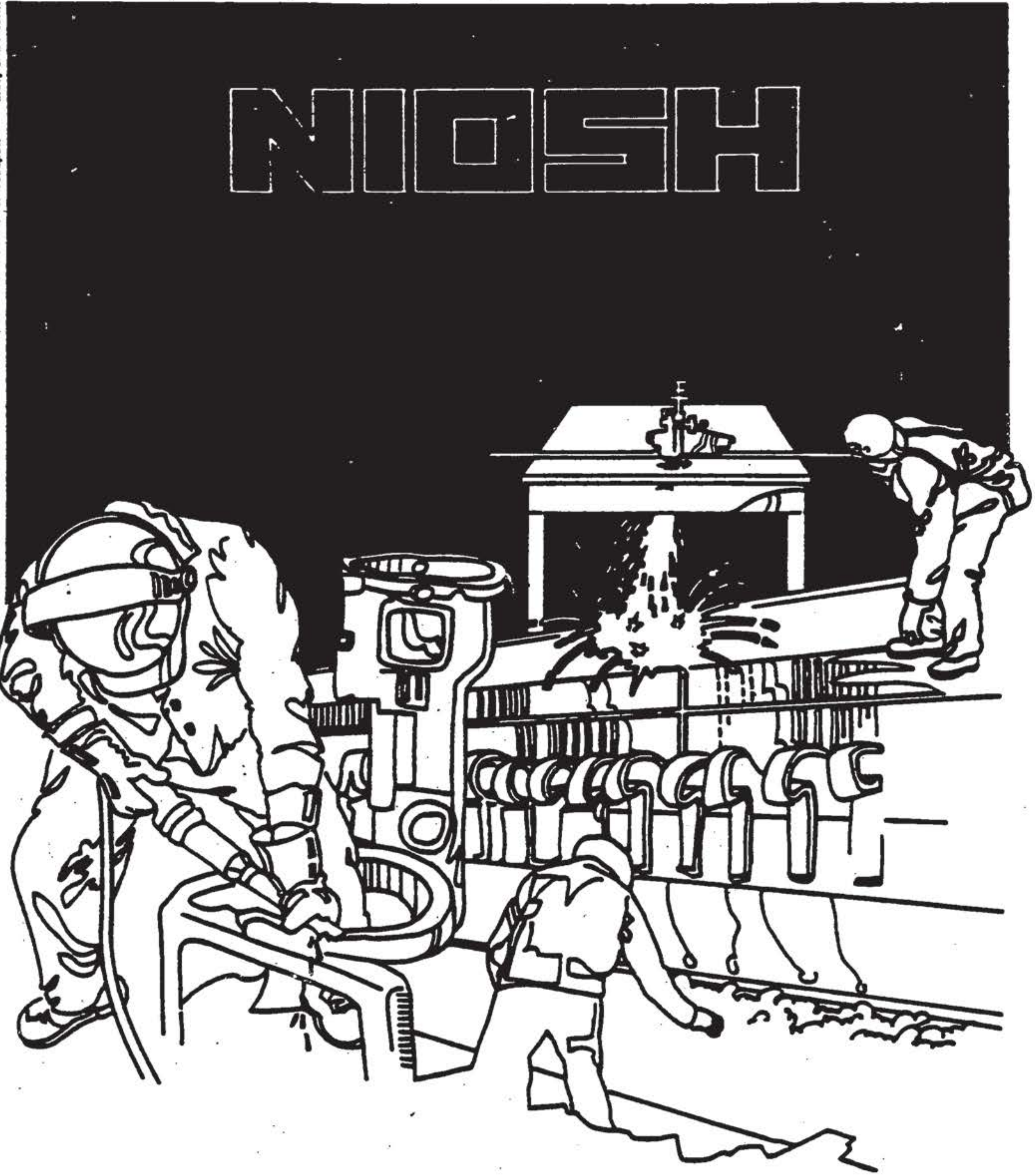

Health Hazard Evaluation Report

HETA 84-006-1639
FIRST NATIONAL BANK
CHICAGO, ILLINOIS

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 84-006-1639
DECEMBER, 1985
FIRST NATIONAL BANK
CHICAGO, ILLINOIS

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I. SUMMARY

On September 28, 1983, the National Institute for Occupational Safety and Health (NIOSH) was contacted by the Chicago Fire Department, requesting technical assistance concerning potential toxic effects of a fire then in progress in a Commonwealth Edison transformer vault beneath the First National Bank Building, Chicago, Illinois. The fire resulted in the loss of 15 gallons of oil, composed of 65% Polychlorinated Biphenyls (PCB - Arochlor 1260), and 35% trichlorobenzene, from one of four transformers in the vault.

During the next 24 hours representatives from the utility company and the Illinois Environmental Protection Agency collected environmental wipe samples, air samples, and air filters from the ventilation system to determine the areas of PCB contamination. NIOSH investigators interviewed and drew blood samples for PCB, Polychlorinated Dibenzofurans (PCDF), and Polychlorinated Dibenzodioxins (PCDD) analysis from 2 firefighters who were hospitalized for smoke inhalation after a 15 minute exposure, and 2 maintenance workers who were in areas adjacent to the vault for 3 and 12 hours following the fire. None of these exposed individuals wore respiratory protection at that time.

Analysis of the environmental samples indicated the PCB contamination was limited to the vault at 20,900 micrograms per square foot (ug/ft^2). The adjacent fan room which supplied ventilation to the plaza building and sublevels revealed 22,000 to 39,100 micrograms per gram (ug/g) on the air handling filters. The ventilation shafts from the vault itself had 16,800 and 14,300 ug/ft^2. The exterior surface of the one-story plaza building contained 8,900 ug/ft^2. PCB levels from the office tower (.03-1.1 ug/ft^2) were comparable to background surface concentrations taken from uninvolved areas of adjacent buildings (0.5 to 4.7 ug/ft^2), while PCB levels in adjacent areas of the parking garage (18.9 to 47.6 ug/ft^2) were above background. The air concentration of PCB in the vault 4 hours after the fire was 58 ug/m^3, which is in excess of the NIOSH recommended exposure limit of 1 ug/m^3.

The soot from a surface wipe sample taken from the ceiling of the transformer vault contained 114 ug/ft^2 of total PCDF/PCDD (tetra through octa compounds). The transformer oil contained 5.1 parts per million (ppm) of total PCDF.

Serum PCB levels were less than 10 parts per billion (ppb) on all 4 exposed individuals. No PCDFs or PCDDs were detected in the blood of these individuals at a detection limit varying between samples of 3 to 40 parts per trillion (ppt).

Based on the results, of this study it has been determined that a potential health hazard existed due to exposure to PCB, PCDD, and PCDF at this Chicago transformer fire. Despite this potential, no absorption of PCB, PCDF, nor PCDD could be detected in the blood of four exposed individuals.

Key Words: SIC 9224(fire protection), 4911(electrical services), Firefighters, Polychlorinated Biphenyls (PCB), Polychlorinated Dibenzo Dioxins (PCDD), Polychlorinated Dibenzo Furans (PCDF), TCDD, Dioxin.

II. INTRODUCTION

On September 28, 1983, the National Institute For Occupational Safety and Health was contacted by the Chicago Fire Department, requesting technical assistance concerning potential toxic effects of a fire then in progress in a Commonwealth Edison transformer vault beneath the First National Bank Building, Chicago, Illinois. Advice was offered as to appropriate medical evaluations and tests, substances potentially involved, and individuals exposed.

III. BACKGROUND

Commonwealth Edison, the electrical utility company in the City of Chicago, maintains approximately 1,900 transformers containing polychlorinated biphenyl (PCB) askarels beneath the streets of the Loop business area of Chicago. On September 28, 1983, a fire occurred in a bus bar between a transformer and the switchgear in a transformer vault located under the plaza on the same block as the First National Bank Building, Chicago, Illinois. Although the transformer was de-energized after 10 minutes, smoke continued to rise from the ventilation shaft onto the sidewalk for approximately 45 minutes. One of the four transformers in the vault had leaked approximately 15 gallons of askarel coolant consisting of 65% Aroclor 1260 and 35% chlorinated benzenes. The source of the leak was a small hole in the transformer casing that was caused by the heat generated by the fire or by electrical arcing.

IV. METHODS AND MATERIALS

A. Environmental

During the next 24 hours, the utility company and the Illinois Environmental Protection Agency collected wipe samples, air samples, and air filters from the ventilation systems to assess the areas of PCB contamination. PCB wipe samples were collected using Whatman filter paper saturated with hexane. The area wiped was one square foot. Air samples collected for PCB content were collected on Florisil tubes at a flow rate of 100 cc/minute for 1, 6, and 8 hours. NIOSH investigators supervised the collection of a wipe sample taken from the vault wall and a bulk askarel sample from the damaged transformer for polychlorinated dibenzo dioxins (PCDD) and polychlorinated dibenzo furans (PCDF) analysis. This square foot wipe sample was collected using a glass wool fiber wipe saturated with pesticide grade hexane.

NIOSH investigators interviewed and drew blood samples for PCB, PCDF, and PCDD analysis from 5 individuals with the highest acute exposures 24 - 48 hours after the fire. The blood samples from one individual were damaged in transit and no analysis was possible. The remaining 4 individuals consisted of 2 off-duty firefighters who were hospitalized for smoke inhalation after a 15 minute exposure and 2 maintenance workers who were in areas adjacent to the vault for 3 and 12 hours respectively. None of these exposed individuals wore respiratory protection at that time.

PCB environmental samples were analyzed by the utility company using hexane extraction and gas chromatography. PCB blood samples were analyzed by Metpath Laboratories using gas chromatography with an electron capture detector.

Samples for PCDD and PCDF analysis were sent to the Brehm Laboratory at Wright State University. The PCDDs and PCDFs were extracted from the blood with hexane and cleaned using a combination of silica and alumina gel chromatography. The askarel proceeded through a two-step cleanup procedure: 1) separation of the PCBs and any PCDFs and PCDDs from the askarel matrix by column chromatography on florisil and liquid-liquid partition; and 2) separation of the PCBs from any PCDFs and PCDDs by selective absorption on alumina. The cleanup procedure was effective in removing approximately 99% of the PCBs from a 3.66 gram sample of askarel. Analysis of the cleaned-up extracts was completed using a high resolution capillary column gas chromatograph (HR/GC) interfaced to a mass spectrometer operated in the selected ion monitoring mode (SIM-MS). The samples were analyzed for PCDFs and PCDDs by chlorine isomer group (tetrachloro through octachloro compounds).[1]

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's) and 3) the U.S. Department of Labor, Occupational Safety and Health Administration's (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based solely on concerns relating to the prevention of Occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970, (29 USC 651, et seq) to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

A. Polychlorinated Biphenyls (PCBs)

PCBs are a class of chlorinated aromatic hydrocarbons. They were first available in the United States in 1929, and became widely distributed between 1957 and 1977 marketed under the trade name "Arochlor". At least nine different Arochlors were manufactured, and designated by numbers such as 1221, 1242, 1254, and 1260, where the last two digits represent the percent by weight of chlorine.[2]

In human beings, high dose PCB exposure has been documented to produce a variety of toxic effects including chloracne, contact dermatitis, upper airway irritation, nausea and digestive disturbances, mild asymptomatic liver dysfunction, dysfunction of sensory and motor nerves in the extremities.[3] Recently these compounds have been found to cause lower birth weight and smaller head circumference in newborns whose mothers ate PCB contaminated fish during pregnancy.[4]

Based on the adverse reproductive and tumorigenic effects that PCBs have shown in experimental animals, NIOSH recommends that occupational exposure to PCBs be controlled so that no worker is exposed at an airborne concentration greater than 1.0 ug/M^3 total PCBs as a TWA concentration for up to a 10-hour workday, 40-hour workweek.[2] In addition, NIOSH recommends that exposure to PCBs through skin contact be minimized through the use of safe work practices and proper personal protective equipment.

The current OSHA standard for exposure to PCBs is 1.0 mg/M^3 for PCB mixtures containing 42% chlorine, and 0.5 mg/M^3 for mixtures containing 54% chlorine as an 8-hour TWA concentration.[5] There is neither an ACGIH TLV or OSHA Permissible Exposure Limit for Aroclor 1260, the PCB class contained in the First National Bank transformer.

Laboratory experiments[6] and industrial studies[7] have documented cutaneous absorption of PCBs. The final Environmental Protection Agency (EPA) regulation on environmental PCB contamination (40 CFR Part 761, Federal Register Vol. 47, No. 165, August 25, 1982) does not include a specific guideline to define the extent of cleanup required for PCB releases. The regulation does state, however, that all spills, leaks, and other uncontrolled discharges should be cleaned up to pre-existing background levels whenever there is threat of contamination of water, food, feed, or human beings.[8]

Data collected in non-manufacturing buildings in Cincinnati, Ohio; Maplewood, Minnesota; and Boston, Massachusetts suggest an upper limit background PCB concentration of 0.5 ug/100 cm^2 (range §0.01 to 0.45, mean 0.09, S.D. + 0.08, N = 125).[9] Due to the above background environmental levels of PCBs, a number of studies have demonstrated that PCBs can be found in the serum of most persons residing in the United States. These studies have reported serum PCB values from 0 to 42 parts per billion (ppb), with mean concentrations ranging from 2.1 to 24.4 ppb.[10]

B. Chlorinated Benzenes

In humans, chlorinated benzenes have been noted to cause irritation to skin and mucous membranes and, at high doses, affect central nervous system function. Chronic high level exposures in animal studies have produced liver, kidney, and lung damage.[11] Based on the irritative properties of this substance, ACGIH has recommended that exposure to 1,2,4-trichlorobenzene should not exceed 5 parts of contaminant per million parts of air (ppm) or 40 mg/M^3 at any time.[12] There are no available recommended exposure level standards for tetrachlorobenzene.

C. Polychlorinated Dibenzo Dioxins (PCDDs)

The general chemical structure for chlorinated dioxins is two benzene rings linked by two oxygen atoms with varying numbers of chlorine atoms attached to the rings. The most toxic of these compounds is the isomer 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). TCDD has been found to cause chloracne, a variety of both central and peripheral nervous system abnormalities, weight loss, anorexia, abdominal pain, hepatomegaly, acute hepatitis and Porphyria Cutanea Tarda. In animals, the immune system, kidney, thyroid and respiratory system are targets of the toxin.[13] NIOSH considers TCDD a potential human teratogen and carcinogen and recommends environmental control to the lowest technically feasible level.[14]

D. Polychlorinated Dibenzo Furans (PCDFs)

The mechanism of toxic action of PCDFs is not known. As many as 135 isomers of PCDF have been identified. As with the PCDD the toxicity of these compounds differs markedly depending on the isomer involved. The most toxic of these compounds is 2,3,7,8, tetra-CDF, which has an LD 50 value (the lethal dose in micrograms per kilogram of body weight for 50% of the animals tested) of 5.0 ug/kg when administered orally to guinea pigs. The toxic effects of PCDF's are similar to those of TCDD in animals.[15]

VI. RESULTS

The results of environmental sampling for PCBs are presented in Table 1. PCB contamination was limited to the vault where readings of 20,900 micrograms per square foot (ug/ft^2) were found. Twenty two thousand (22,000) to 39,100 micrograms per gram (ug/g) of PCB's were found on the intake side of the air handling filters in the adjacent fan room. The ventilation shafts from the vault itself contained 16,800 and 14,300 ug/ft^2, and the exterior surface of the one-story plaza building measured 8,900 ug/ft^2. PCB levels from the office tower (.03-1.1 ug/ft^2) were comparable to background surface concentrations (0.5 to 4.7 ug/ft^2), while PCB levels in the parking garage (18.9 to 47.6 ug/ft^2) were above background. The air concentration of PCB in the vault 4 hours after the fire was 58 ug/m^3, which is in excess of the NIOSH recommended exposure limit of 1 ug/m^3.

While the plaza structure and office tower were connected at several sublevels, spread of the smoke into the office tower was prevented by the presence of the two separate ventilation systems and intentional positive pressurization of the office tower during the fire. Contamination of the plaza structure was minimized by shutting off the ventilation fans shortly after the fire began and by the presence of high efficiency filters on these fans. Smoke was purposely routed into the underground garage from the fan room by opening the ventilation duct leading to the garage.

Table 2 presents the PCDF/PCDD analysis of soot from a surface wipe sample taken from the ceiling of the transformer vault. The sample contained 114 ug/ft^2 of total PCDF/PCDD (tetra through octa compounds). A corresponding surface wipe sample obtained from the wall of the vault contained 20,900 ug/ft^2 of PCBs. The ratio of PCBs to total PCDF/PCDDs is approximately 183:1. TCDFs comprised 25% of total PCDFs. 2,3,7,8-TCDF comprised 3% of total PCDFs. Table 3 presents the PCDF/PCDD analysis of the askarel from the damaged transformer. The askarel contained 5.1 ppm of total PCDF. The ratio of PCBs to total PCDF/PCDDs is 127,451:1. TCDFs comprised 4.5% of total PCDFs in the unburned askarel.

Serum PCB levels were less than 10 parts per billion (ppb) on all 4 exposed individuals. No PCDFs or PCDDs were detected in the blood of these individuals at a detection limit varying between samples of 3 to 40 ppt.

VII. DISCUSSION

The potential toxic hazard of PCB-askarel transformer and capacitor fires has only been recognized in recent years. Capacitor grade PCB-askarel is a relatively pure PCB fluid. Transformer grade PCB-askarel may be relatively pure PCBs or a mixture of PCBs and chlorinated benzenes. In 1978 Buser, Bosshardt, and Rappe demonstrated the formation of PCDFs from the pyrolysis of PCBs.[16,17] In 1979 Buser reported the formation of PCDFs and PCDDs from the pyrolysis of chlorinated benzenes.18 PCDFs and other pyrosynthesis products have been detected in the soot from transformer fires in Canada in 1977[19], and the U.S.A. in 1981 and 1983;[20,21] and capacitor fires in Sweden in 1978 and 1981[15,22].

Soot formed from the combustion of PCB askarels in transformer and capacitor fires can contain a complex mixture of potentially toxic chlorinated products. In addition to PCDFs and PCDDs, the soot may contain polychlorinated biphenylenes and polychlorinated nuclear aromatics such as chlorinated pyrenes and chrysenes[20]. The concentrations of these pyrosynthesis products can vary widely depending on the specific conditions of the fire. The major pyrosynthesis product relative to concentration in soot appears to be PCDFs. TCDFs comprise a major fraction of PCDFs, of which 2,3,7,8-TCDF is one of the most abundant isomers. PCDF concentrations in several U.S. transformer fires have ranged from 46 to 4761 ug/g of soot[20]. Concentrations of 2,3,7,8-TCDF in these same fires ranged from 3 to 273 ug/g of soot.

The ratio of PCBs to total PCDFs/PCDDs is useful in assessing the extent of PCDF/PCDD contamination. Once established for a given fire, this ratio can permit the use of PCB analysis as a surrogate for PCDF/PCDD analysis. The PCB:PCDF/PCDD ratio in the Chicago fire was 183:1, which falls between the ratios in the San Francisco fire (300:1) and the Binghampton fire (16:1). 2,3,7,8-TCDF comprised 3% of the total PCDFs in the Chicago fire compared to 2% in the San Francisco fire and 17% in the Binghampton fire. A comparison of the PCB:PCDF/PCDD ratio and relative distribution of PCDF congeners in the unburned askarel and soot demonstrates the pyrosynthesis of PCDFs.

Few investigators have examined or bioassayed firefighters or clean-up workers to evaluate the acute and subacute health effects from these types of exposures. Seppalainen et al reported quick resolution of acute symptoms of nausea, intensive perspiration, and headache in workers briefly exposed to PCBs and PCDFs following a capacitor explosion[23]. Neurophysiologic testing of these workers revealed a slight, reversible impairment of distal sensory nerve conduction velocity. Serum PCB levels peaked at 3 days (5-30 ppb; median = 13 ppb) and decreased to baseline within 1-2 months of exposure.

Orris et. al. reported acute symptoms of skin irritation, unusual tiredness, and headaches in approximately 20% of firefighters exposed to a PCB aerosol following a transformer overheat.[24] Serum PCB levels in these firefighters 1-2 days after exposure ranged from 10-16 ppb. Jansson and Sundstrom reported serum PCB levels of 2.3-3.6 ppb in firefighters drawn several weeks after their exposure to PCBs and PCDFs in a capacitor fire[22]. No PCDFs were detected in the blood of these firefighters at a detection limit of 100-200 ppt. Tiernen et al found no PCDFs or PCDDs (detection limit 10-30 ppt) in the blood of individuals exposed to PCDF and PCDD-containing soot after the Binghampton transformer fire! The failure to detect PCBs at a detection limit of 10 ppb or PCDFs/PCDDs at a detection limit of 3-40 ppt in the blood of the 4 individuals exposed in the Chicago fire is consistent with these previous studies.

There are as yet no epidemiologic studies of chronic health effects in persons exposed to PCB-askarels and their pyrolysis products as the result of transformer or capacitor fires. Risk assessments have

been based on extrapolation of dose-response relationships for these compounds from animals to man. The underlying assumptions have varied for different transformer fires[25]. Decontamination guidelines for the Binghampton transformer fire were based on the assumption that the major hazard of exposure to PCDFs and PCDDs, expressed as 2,3,7,8-TCDD equivalents, was the development of non-neoplastic long term health effects. Decontamination guidelines for the San Francisco transformer fire were based on the assumption that the major hazard of exposure to these compounds is carcinogenesis.

The New York State Department of Health has developed re-entry guidelines to assist in the clean-up of the Binghampton office building. The maximal surface contamination level of 2,3,7,8-TCDD equivalents depends on the air concentration: if the air concentration is less than 10 pg/m^3, then the maximal surface level is 28 ng/m^2; if the air concentration is greater than 10 pg/m^3, then the maximal surface level is 3.3 ng/m^2. The equivalent toxicity of the known contaminants on the surface of the vault in the Chicago fire would be 90,400 ng/m^2 (8,405 ng/ft^2) which is in excess of the NYSDH 3.3 ng/m^2 guideline.

This study confirms the laboratory findings of production of PCDFs from the pyrolysis of PCB/Chlorinated Benzene containing transformers. No TCDD, PCDD, nor HxCDD were formed during this fire. Individuals transiently exposed to the smoke of these fires without respiratory protection do not reveal measurable amounts of PCDDs nor PCDFS in their blood.

VIII. RECOMMENDATIONS

NIOSH believes that fire-related transformer incidents can present risks of exposure by emergency response personnel, cleanup workers and others to toxic contaminants such as volatilized PCBs and certain pyrolysis products of PCB-askarels. The following recommendations are intended to help prevent significant exposures by emergency response workers and others involved in these incidents.

A. Prevention

Institution of fire hazard inspection and preventive programs may be the initial step to reduce the likelihood of future fires involving this equipment. These programs should include, on a regular and frequent basis, (a) preventive maintenance of the various electrical components used in conjunction with transformers (switchgear, breakers, cables, etc.) and (b) inspections to assure proper dielectric fluid levels and that combustibles are not in a transformer vault or in the immediate area of a transformer. Measures to mitigate the risks associated with a transformer fire-related incident should include the following:

1. A method to quickly disconnect the power to the transformer. The installation of circuit breakers on the high voltage side, perhaps activated by temperature, infrared or ionization based sensors in the vault, would do much to reduce the duration of the incident and other conditions conducive to the formation of the toxic pyrolytic products.
2. The installation of a network protector on the secondary side of the transformer which would prevent current from being fed back into a failed transformer.
3. The installation of secondary disconnect switches exterior to the transformer room.
4. The development of architectural design features to seal off the vault from other areas of the building or adjacent buildings.
5. Since continued operation of the building's heating, ventilation, and air conditioning (HVAC) system can contribute to the spread of contamination, the HVAC controls could be keyed to a fire or smoke sensor in the vault to allow for automatic shut down in the case of a fire.

B. Emergency Response

The highest priority in responding to a PCB-transformer incident is to prevent exposures of emergency response personnel such as fire fighters. One of the primary factors that increase the risks of exposure is fire fighters being unaware that they are responding to a fire-related incident involving a PCB-transformer. The registration of PCB -transformers with local fire departments may be the most effective way of assuring early recognition of the potential hazards in the event of fire. This registration should include for each transformer (a) serial number, manufacture and kilovolt/amperage (KVA) rating; (b) total volume and generic composition of dielectric fluid; and (c) exact location. Another way of assuring early recognition is through signs and labeling. Although all PCB-transformers are required by the United States Environmental Protection Agency (USEPA) to be labelled (47 FR 3742, Aug. 25, 1982), this labeling should also be placed in the other areas near the transformer location indicating that a PCB-transformer is in the building. Additionally, the exterior of the transformer vault doors should be labeled at heights of approximately two- and five-feet above the floor. The label at the two-foot height would likely be visible to a fire fighter crawling in a smoke filled area.

1. Protective Clothing and Equipment

A fire fighter entering any area in which there might be airborne exposure to the contaminants should wear a Self Contained Breathing Apparatus (SCBA), with full facepiece, operated in the positive pressure mode. In addition to wearing standard firefighter protective turn-out clothing, consideration should be given to the utilization of disposable coveralls because of the uncertain efficacy of decontamination of clothing. If exposure is to combustion soot, the coveralls should be made of a non-woven fabric such as spunbonded polythylene, Tyvek. In cases of exposure to liquids, the coveralls should be made of chemically resistant materials such as disposable laminates, e.g., Saranex coated Tyvek.[26]

2. Decontamination of Protective Clothing and Equipment

All disposable clothing should be placed in marked and USEPA approved containers (47 FR 37342, Aug. 25, 1982) and disposed of appropriately. All reusable clothing and equipment should be grouped according to perceived degree of contamination (i.e., high, moderate, or low). These pieces may be initially cleaned on site with a nonionic synthetic detergent, beginning with the material thought to be least contaminated. All materials should be rinsed twice with a clean solution of the nonionic synthetic detergent.

Decisions concerning decontamination endpoints are often based on the lack of visible contamination; however, the absence of observable surface contamination does not necessarily indicate the absence of contaminants absorbed into the material. Reusable clothing and equipment should, therefore, be checked for residual contamination before reuse or storage.

As the costs of testing the adequacy of the clothing decontamination is often more expensive than replacing the piece itself, it may frequently be bypassed. NIOSH is currently evaluating a decontamination method utilizing Freon 113. In initial tests this method appears to be effective in removing over 95Δ of the chlorinated aromatic compounds from clothing. It may therefore prove valuable as a final decontamination step, as this method would not require post-decontamination testing in most situations.

C. Medical

A medical surveillance program should be established to prevent (or to attempt to detect at an early stage) adverse health effects in workers resulting from exposure to PCB's or related compounds. Medical and work histories, including previous exposure to PCB/s or other toxic agents, should be taken for each worker and updated periodically. The physician responsible should be provided with information concerning the adverse health effects from exposure to PCB's and related compounds and an estimate of the workers potential exposure, including any available workplace sampling results and a description of all protective clothing or equipment the worker may be required to use.

The examining physician should direct particular attention to the skin, liver, and nervous system as these are the most likely targets of exposure to PCB's and related compounds. Blood determinations which reflect liver function may be useful. Measurement of blood PCB's may also be useful but should not be interpreted as a sensitive indicator of acute exposure. Adipose tissue levels of PCB's, PCDF's and PCDD's are indicative of total body burden but these samples are not routinely available. Further studies of exposed populations will permit more definitive medical monitoring recommendations. No special medical surveillance program is necessary for these workers with occasional exposure to PCB in transformer incidents.

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11. Illinois EPA
12. Division of Occupational Medicine, Cook County Hospital

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

PCB Sampling Results
Following A Transformer Fire, Chicago Illinois, 1983

Location	Type of Sample	Result
Transformer Vault Wall	Wipe (ug/ft^2)	20,900
Street Above Vault		
Intake grill	Wipe	16,800
Exhaust	Wipe	14,300
Building window above vault	Wipe	8,900
Sidewalk 100 ft E. of vault	Wipe	51
Plaza Building Corridor	Wipe	0.3
Office Tower		
Main floor south	Wipe	1.1
Level 2 W. entrances	Wipe	1.1
20th floor interior	Wipe	0.03
32nd floor southwest	Wipe	0.03
50th floor interior	Wipe	0.03
Garage (Plaza Sublevels)		
N. end lower level	Wipe	47.6
S. end lower level	Wipe	18.9
N. end upper level	Wipe	31.8
S. end upper level	Wipe	41.4
Exhaust Air filters	Front of Filter/ Rear of Filter (ppm)	
Office Tower		
58th floor S.W.	Filter F/R	9/7
40th floor S.E.	Filter F/R	12/6
23rd floor S.E.	Filter F/R	41/51
4th floor S.W.	Filter F/R	89/93
3rd floor S.W.	Filter F/R	19/16
Plaza Building and Sublevels		
Vault level (plaza supply)	Filter F/R	22,000/11,300
Vault level	Filter F/R	18.3/8.4
Vault level	Filter F/R	4.4/3.2
Garage	Filter F/R	39,100/28,100
Plaza Building	Air (ug/m^3)	<10
Transformer Vault (4 hrs.after the fire)	Air	58

Table 2

PCBs, PCDFs, And PCDDs In Wipe Samples From The Interior Of The Transformer Vault (ng/ft^2), Chicago, 1983.

PCBs[1] 20,900,000

PCDFs		PCDDs		
2,3,7,8-TCDF[2]	3,800	2,3,7,8-TCDD	N.D.[3]	(5)
Total Tetra	28,000	Total Tetra	N.D.	(5)
Penta	40,000	Penta	N.D.	(25)
Hexa	33,000	Hexa	N.D.	(55)
Hepta	11,200	Hepta	314	
Octa	1,238	Octa	127	
Total PCDFs	113,438	Total PCDDs	441	

1. PCBs from wipe of vault wall; PCDFs and PCDDs from wipe of vault ceiling.

2. 2,3,7,8-TCDF and Co-eluting Isomers.

3. Not Detected; detection limit in parentheses.

Table 3

PCBs, PCDFs, And PCDDs
In The Transformer Oil After The Fire (ng/g or ppb), Chicago, 1983.

PCBs[1] 650,000,000

PCDFs		PCDDs		
2,3,7,8-TCDF[1]	75	2,3,7,8-TCDD	N.D.[2]	(2.5)
Total Tetra	230	Total Tetra	N.D.	(2.5)
Penta	440	Penta	N.D.	(2.5)
Hexa	980	Hexa	N.D.	(3.0)
Hepta	1,850	Hepta	N.D.	(2.0)
Octa	1,600	Octa	8.0	
Total PCDFs	5,100	Total PCDDs	8.0	

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1. 2,3,7,8-TCDF and Co-eluting Isomers .
2. Not Detected; detection limit in parentheses.

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