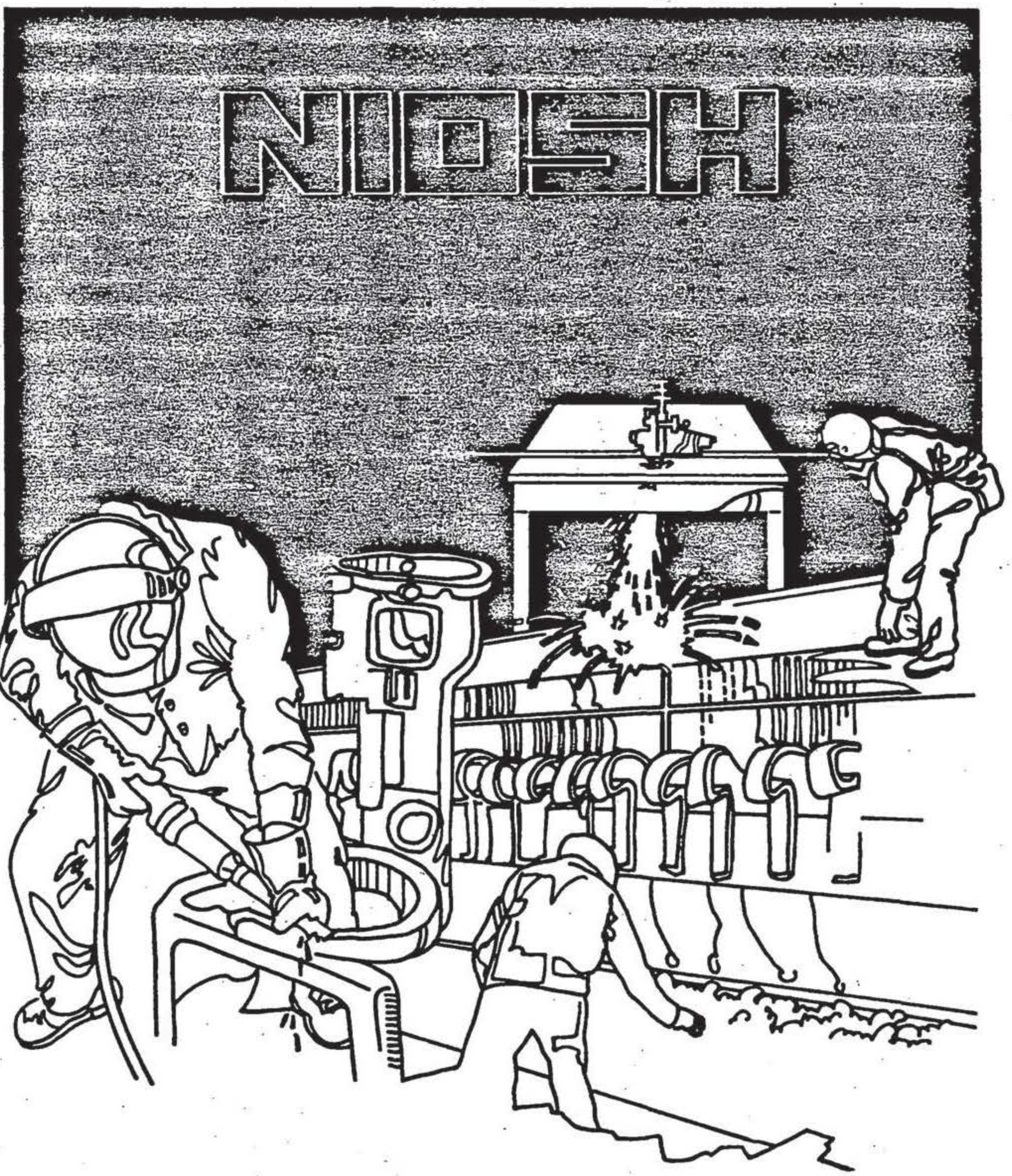
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public [illegible] Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 82-224-1336
MIAMI FIRE DEPARTMENT
MIAMI, FLORIDA

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 82-224-1336
JULY 1983
MIAMI FIRE DEPARTMENT
MIAMI, FLORIDA

NIOSH INVESTIGATORS:
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I. SUMMARY

On April 15, 1982, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate the possiblity that fire fighters assigned to the Miami Fire Department had been exposed to polychlorinated biphenyls (PCBs) during an electrical fire inside an underground transformer vault located in downtown Miami, Florida. On April 16, 1982, three days after the fire, and subsequent to cleanup of the vault by the power company, NIOSH investigators collected surface wipe samples and bulk samples of soot inside the vault. Additional samples were collected from fire fighters' turnout coats, from respirator face masks, and from other fire fighting equipment thought to have been in contact with smoke from the fire. Surface swipe samples were analyzed for PCBs using the Webb-McCall method, and bulk samples were analyzed for polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) by high resolution gas chromatography/mass spectrometry (HRGC/MS).

Analyses of wipe samples of soot from inside the vault detected PCB concentrations ranging from 2 to 860 micrograms (ug) per 100 cm^2 of surface sampled. A contamination level of 27,400 ug/100 cm^2 was detected on the vault floor, possibly contaminated from the PCB spill which occurred inside the vault during the fire. PCBs were not detected on fire fighters' protective clothing. The soot coated fan blade guard of a smoke ejector fan had a contamination level of at least 31 ug/100 cm^2.

Analyses of six bulk samples of soot did not detect PCDD isomers. Two samples contained 1.89 ug/g and 0.78 ug/g respectively of various isomers of tri-, tetra-, penta-, and hexa-chloro dibenzofurans. 2,3,7,8-tetrachlorodibenzofuran was not detected in the samples. Bulk samples contained considerable amounts of polychlorinated diphenylethers; however, exact concentrations were not determined.

Although there are currently no established criteria for exposure to PCB contaminated surfaces, other NIOSH studies have found normal background levels for uncontaminated surfaces to be less than 0.5 ug/100 cm^2. There are currently no criteria for PCDF contaminated surfaces. PCDFs have been previously found as trace contaminants and as products of combustion in PCB oils.

Based on results of samples collected, NIOSH has determined that fire fighters had potential exposure to PCBs and PCDFs. PCB contamination was detected inside the vault, after cleanup had been completed by the power company. Protective clothing used by fire fighters was not contaminated, but equipment in direct contact with smoke from the fire was contaminated. The results support the findings of other studies which indicate that polychlorinated dibenzofurans are trace contaminants of technical grade PCB oils and may be produced during fires involving PCBs. Recommendations for preventing contamination during fires involving PCB type transformers are contained in this report.

KEYWORDS: SIC 9224 (Fire Protection), SIC 4911 (Electric Services), transformer-fires, PCBs, dioxins, furans, polychlorinated dibenzodioxins, (PCDDs), polychlorinated dibenzofurans, (PCDFs), 2,3,7,8-tetrachlorodibenzodioxin (CAS 1746-01-6), 2,3,7,8-tetrachlorodibenzofuran (CAS 51207-31-9)

II. INTRODUCTION

On April 15, 1982, the National Institute for Occupational Safety and Health (NIOSH) was requested by the International Association of Fire Fighters (IAFF), on behalf of the Miami Association of Fire Fighters, to evaluate the potential health hazards for fire fighters of the Miami Fire Department. On April 13, 1982, fire fighters from Station No. 1 responded to an electrical transformer fire in an underground vault located under a sidewalk in the central downtown business district of Miami, Florida. Fire fighters were concerned they may have been exposed to polychlorinated biphenyls (PCBs) and other toxic combustion products released from the transformer during the fire.

This transformer fire appeared to be similar to the fire which occurred in February, 1981, in the basement of an 18-story state office building in Binghamton, New York. In that fire, the intense heat from an electrical fire in switchgear equipment broke the ceramic bushings on a transformer releasing 180 gal. of PCB oil onto the basement floor. Vapors from the evaporating PCB oil may have been partially converted to polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) as they passed through the flames and were distributed throughout the building by the ventilation system. PCDDs and PCDFs were subsequently identifed in soot samples taken from the building's interior.[1]

Because the discription of the Miami transformer fire appeared to be very similar to the fire in the New York state office building, NIOSH investigators were sent promptly to the scene to evaluate the extent of PCB contamination, and to determine if smoke and soot may have contained highly toxic PCDDs and PCDFs. A report describing the actions taken by NIOSH during the site visit was submitted to the IAFF on May 13, 1983. An interim report with results of the analyses of soot samples was submitted to the IAFF, the Miami Association of Fire Fighters, The Miami Fire Department, and the Florida Power and Light Company on October 22, 1982.

III. BACKGROUND

On April 13, 1982, a fire and explosion occured when a transformer "chamber" exploded, releasing approximately 100 gallons of PCB transformer oil onto the floor of the electrical vault. Approximately 30 fire fighters from the Miami Fire Department, Station No. 1, responded. The fire self-extinguished in about 10 minutes, but fire fighters subsequently set up smoke ejector fans to ventilate the vault. Because a dense black smoke was released, fire fighters evacuated a nearby restaurant.

After the smoke had ventilated from the vault, a maintanence crew from the Florida Power and Light Company (FP&L) removed the damaged transformer and cleaned out the vault. Apparently no respiratory protective equipment was used by the crew during cleanup. The vault contained 5 other transformers which were not damaged. Representatives from FP&L reported that the damaged transformer had contained 300 gallons of PCB oil, but the chamber which had exploded contained only a small amount (apx. 2 gal.) of mineral oil. FP&L officials stated they did not believe PCB oils had burned during the fire. They suspected that the PCB oil had simply leaked from the transformer through damaged insulators broken open by the force of the exploding chamber.

IV. EVALUATION DESIGN AND METHODS

On the morning of April 16, 1982, NIOSH investigators met with the Chief and with other representatives of the Miami Fire Department to discuss the purpose and scope of the NIOSH survey. The NIOSH team was then taken to the electrical vault where they met with representatives of FP&L. A maintenance crew had opened the transformer vault to permit access to the area where the fire had occurred. Wearing disposal coveralls, shoe covers, disposable gloves, and respiratory protection, the NIOSH team entered the vault to collect samples of soot and other residue created by the fire. No transformer oil was present on the floor because a FP&L maintenance crew had previously cleaned the vault and removed the damaged transformer immediately after the fire. A replacement transformer had not yet been installed.

Wipe samples taken from surfaces near the fire scene were collected with sterile cotton pads saturated with n-hexane. Additional wipe samples from other surfaces thought to be less heavily contaminated were wiped using dry Whatman smear tabs. Where possible (on large flat surfaces), the collection media was wiped over an area measuring approximately 100 cm^2; however, precise dimensions were not determined. Bulk samples of soot and other suspected combustion products were scraped from surfaces and electrical equipment located directly above or very close to the area where the transformer had exploded. Because these were bulk samples and the surfaces scraped had a very heavy build-up of dirt and suspected combustion products, no attempt was made to collect material from a 100 cm^2 area. Because fire fighters also were concerned about possible PCB contamination of fire equipment and protective clothing used during the fire, the NIOSH investigators visited the fire station where several coats, respirators, face masks, and other fire equipment used at the scene were sampled for surface contamination as described above using cotton pads dipped in n-hexane or using dry Whatman smear tabs.

Seven swipe samples (cotton pads soaked in n-hexane) and ten smear tab samples (used dry) were analyzed for NIOSH by the Centers for Disease Control, Center for Environmental Health, Clinical Chemistry Division, Atlanta, Georgia. The swipe and smear tab samples were extracted 3 times or more with 10 mL of benzene in the vial in which they were received by the laboratory. The extracts were then screened and diluted or concentrated as needed using a 40° C water bath and a gentle stream of nitrogen. Quantitation was performed by using the Webb-McCall method, or if interfering peaks were present, by the summation method.

Four bulk samples of soot and other fire residue, and three hexane swipe samples were analyzed by a NIOSH contract laboratory for isomers of PCDFs and PCDDs, of any degree of chlorine substitution, i.e. Cl_1 to Cl_8. Any individual isomers detected were summed to yield a concentration for the group, e.g., the tetrachlorodibenzofurans. The 2,3,7,8,-tetrachloro isomers of the dioxins and furans were reported individually. These samples were extracted with hot benzene and then concentrated. The samples were analyzed using a high resolution gas chromatograph and mass spectrometer (HRGC/MS). Multiple analyses of each sample extract were required to screen for and, if necessary, confirm the presence of the many PCDD and PCDF isomers possible. The detection limit per isomer was usually 10 ng/g for bulk samples and 10 ng/sample for the wipe samples. In a few cases, higher detection limits were necessitated by small sample size or matrix interferences.

A bulk soot sample was also submitted to the NIOSH laboratory for qualitative analysis of organics. The sample was refluxed with methylene chloride and filtered through glass fiber filters to produce a clear extract for analysis. This methylene chloride extract was screened by gas chromatography using a flame ionization detector (FID) and then concentrated to almost dryness and reanalyzed by GC and GC/MS.

V. EVALUATION CRITERIA

A. Polychlorinated Biphenyls

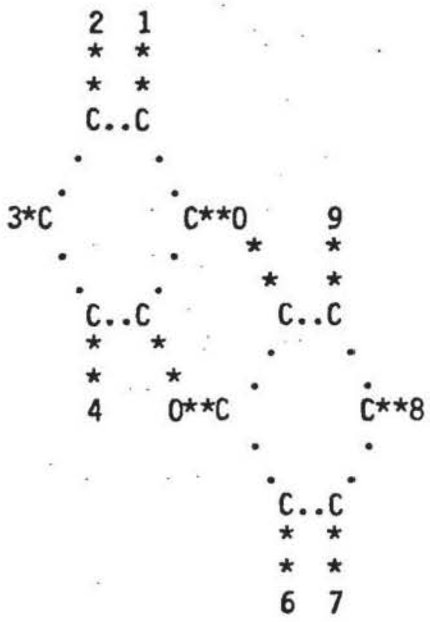
Polychlorinated biphenyls are a group of chlorinated organic chemicals which had wide use in electrical equipment and transformers made between 1921 and 1978. Their exceptional fire resistance and long life in applications involving intense electrical fields and high temperature also renders PCBs extremely resistant to environmental breakdown. In 1978, Congress ordered the Environmental Protection Agency (EPA) to ban the manufacture of PCBs and developed regulations to control their continued use and disposal. According to EPA, any material containing over 50 ppm PCBs must be used, stored, transported, and disposed of in accordance with EPA regulations. In August, 1982, EPA placed further restrictions on the continued use of PCBs in transformers and large capacitors (Fed. Reg. Vol 47. pg 37356-37360). EPA now has three categories of use for PCBs in transformers and electromagnets. Transformers located where leaking PCBs could contaminate the environment must be inspected at least once a week, and must be removed from service by October 1, 1985. Transformers located in vaults or transformers containing less than 6% PCBs must be inspected once a year. All other transformers must be inspected every 3 months. All categories of transformers found to be leaking must be serviced within 24 hours. Inspection and maintenance records on all transformers must be kept for three years after disposal.[1]

Although exposure to PCBs does not usually cause immediate health problems, long-term exposure to PCBs can cause chloracne, liver damage, and irritate the skin and mucous membranes. Chloracne has frequently been associated with processes where PCBs are heated. Toxicity studies have concentrated on the effects of contamination of diets with small amounts of various PCBs. PCBs are poorly metabolized and tend to accumulate in the body, especially in fat tissues.[2] NIOSH recognizes all PCBs as potential carcinogens and recommends an occupational exposure limit of 0.001 mg/M^3 in air. This recommendation is based on data from animal studies which have shown PCBs to be carcinogenic and teratogenic, and hence potentially carcinogenic and teratogenic in man.[3] The NIOSH limit is considered to be the lowest concentration which can be reliably measured by currently available sampling and analytical methods.

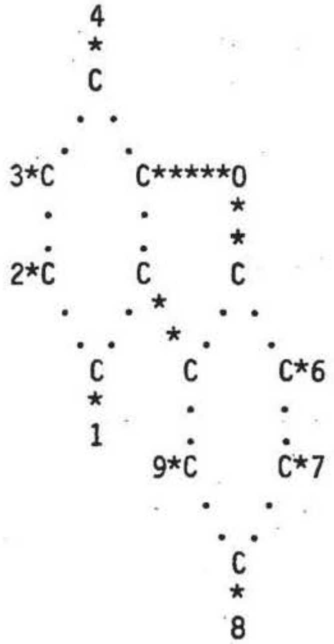
Although laboratory experiments and industrial studies have documented cutaneous absorption of PCBs, there are currently no established criteria for exposure to PCBs on surfaces. It is also generally accepted that determination of health risks from exposures to contaminated surfaces is extremely difficult.

B. Chlorinated Dibenzodioxins (PCDDs) and Dibenzofurans (PCDFs)

PCDFs and PCDDs are tricyclic aromatic compounds which exhibit similar physical, chemical, and biologic properties. The basic structures for these compounds are presented below. The numbers 1 through 9 represent the different positions on the molecule where the chlorine atoms may be attached.



Polychlorinated Dibenzodioxin (PCDD)



Polychlorinated Dibenzofurans

The number of positional isomers is quite large; in all there are 75 PCDDs and 135 PCDFs. The most toxic of these compounds are believed to be 2,3,7,8-tetra-CDD and 2,3,7,8-tetra-CDF, which have LD50 values (the lethal dose in micrograms per kilogram of body weight for 50% of the animals tested) of only 0.6 ug/kg and 5.0 ug/kg respectively when administered orally to guinea pigs. The LD50 dose for rabbits exposed through skin absorption to 2,3,7,8-tetra-CDD is reported to be only 275 ug/kg.[5] Recent research has demonstrated that the positional isomers of PCDDs and PCDFs vary widely in their acute toxicity and biologic activity. For example, 2,3,7,8-tetra-CDD is 1000 to 10,000 times more toxic than 1,2,3,8-tetra-CDD. 2,3,7,8-tetra-CDD has also been identified by the National Toxicology Program as a carcinogen, based on positive results from their carcinogenesis bioassay testing with laboratory mice.[6] Because of their extreme toxicity (some have described PCDFs and PCDDs as the most toxic substances known to man) and the wide variation between different positional isomers, very sensitive and isomer-specific chemical analyses are required to identify and characterize the toxicity of bulk samples collected from the environment which are suspected to contain PCDDs and PCDFs.[7]

VI. RESULTS AND DISCUSSION

The results of the analyses of surface wipe samples are presented in Table 1. As expected, the highest level of PCB contamination was found inside the transformer vault where levels ranged from 2 to 860 ug/100 cm^2. PCBs were detected at 27,000 ug/100 cm^2 in a sample taken from the vault floor under an electrical isolating switch adjacent to the location of the damaged transformer. Based on results from previous NIOSH surveys,[4] it has been observed that usual background levels for PCBs, on non-contaminated surfaces, are less than 0.5 ug/100 cm^2. As indicated in the sampling results, turnout coats and other personal protective equipment had apparently not been contaminated during the fire. This is not surprising since fire fighters allowed the fire to self extinguish, thereby minimizing exposures to the smoke. The only contaminated equipment found at the station was the smoke ejector fan. The result for this sample is indicated on Table 1 as greater than (>) 31 ug/100 cm^2 because the area wiped was less than 100 cm^2.

The results from the analyses of the six bulk samples of soot and other fire residues are presented in Table 2. No PCDDs were detected in these samples. However, PCDFs from tri-CDF to hexa-CDF were detected in two of the six samples. The soot and dust sample taken from a cable support bracket contained 1.89 ug/gm PCDFs and the total concentration of PCDFs found in the soot taken from the smoke ejector fan was 0.78 ug/gm. The highly toxic 2,3,7,8-tetra-CDF was not detected in any of the samples. According to the NIOSH contract laboratory, the samples contained considerable amounts of PCBs and polychlorinated diphenylethers (PCDEs).

Figure 1 is the reconstructed ion chromatogram from the GC/MS analysis performed by the NIOSH laboratory in Cincinnati. The peaks identified in the sample were a series of PCBs; penta-, hexa-, and hepta-chlorobiphenyls; and numerous alkanes, mostly larger than C_{20}.

The results of this survey support other field and laboratory findings which indicate that PCDFs are frequently found as trace contaminants of PCBs or as products of PCB combustion.[7,8] In this survey however, contrary to findings from other studies reporting 2,3,7,8-tetra-CDF as a major constituent of detectable PCDF isomers, no 2,3,7,8,-tetra-CDF was found in any of the samples. It is posible the PCDFs detected in the soot samples were not PCB combustion products, but were present, before the fire, as contaminants of the PCB transformer oil. However, this could not be determined since the damage transformer and spilled PCB oil had been removed from the vault prior to the NIOSH survey.

In addition to PCBs, polychlorinated biphenyl ethers (PCDEs) are also considered to be possible precursors of PCDFs.[7] As mentioned previously, the samples taken from the Miami transformer vault contained considerable amounts of PCDEs. Results from other studies indicate that PCDDs are normally not found as combustion products from PCBs. Furthermore, exposure to smoke from burning transformers represents only one of several possible risks for contact with PCDFs and/or PCDDs. For example, Buser and Bosshardt have found PCDDs and PCDFs in the fly ash and flue gases from municipal incinerators in Switzerland at concentrations of 0.2 ug/gm and 0.1 ug/gm respectively.[8]

Rappe et al.[7] has identified occupations and locations where exposure to these substances may occur; these include:

- chemical plants producing chlorinated phenols or PCBs
- factories utilizing these chemicals for production of other substances, e.g. 2,4,5,-T, phosphorus insecticides or hexachlorophene from 2,4,5,-trichlorophenol
- use of these chemicals under various conditions, such as spraying of herbicides, using chlorinated phenols for a variety of applications: especially as wood preservative, slimacide, bactericide, in cutting fluids, or hide preservation
- use of hexachlorophene by workers in sanitation applications
- factories manufacturing or repairing transformers or capacitors
- factories having heat-exchange systems containing PCBs
- factories utilizing casting waxes containing PCBs
- incinerators where material containing chlorinated phenols, PCBs, polychlorinated or polybrominated diphenyl ethers are incinerated.

VII. CONCLUSIONS

This evaluation indicates that fire fighters are potentially exposed to PCBs and PCDFs during a transformer fire. However, exposures to PCBs and PCDFs from transformer fires represent only one example of the numerous hazardous exposure risks fire fighters face in the performance of their duties. Combustion products of the many plastic and synthetic materials used throughout the interiors of most modern buildings are, for the most part, highly toxic materials. Adequate personal protective equipment, including self-contained breathing apparatus equipped with positive pressure regulators, should be worn any time there is a potential exposure to unknown toxic substances. Contingency plans which address the special health and environmental hazards created when fires involve toxic materials such as as PCBs, pesticides, and highly toxic chemicals should be developed by all fire departments.

VIII. RECOMMENDATIONS

1. Fire departments responding to a transformer fire should be immediately informed as to whether the oils used in this transformer contain or do not contain PCBs. Since EPA requires all power companies to keep detailed inspection and service records on all PCB containing transformers, the information needed by fire departments should be readily available. Power companies should develop procedures to gain immediate access to these records in order to relay the information promptly.

2. All fire fighters should be thoroughly trained and informed about the special hazards involved with PCB fires. Joint FP&L/fire department training programs and field exercises should be considered for training power company crews and fire

fighters, in the procedures required to minimize exposures of personnel and the environment to PCBs and other highly toxic PCB combustion products.

3. Fire fighters should make every effort to avoid direct contact with smoke and residue from a PCB fire in order to prevent contamination of their protective clothing. Conventional turnout clothing will not provide adequate protection from the toxic substances found in PCB fires, and currently there is no recommended method of decontamination.

4. Equipment (not clothing) which becomes contaminated should be washed down at the scene with a kerosene based detergent. Local environmental protection agencies should be notified immediately to advise them about the possibility of contamination of ground or surface water. All run off water thought to be contaminated should be contained with an earth berm and later removed in accordance with applicable EPA and DOT regulations.

5. A training package for fire fighters entitled "Pesticide Fire and Spill Control" (January, 1980) is available from the National Fire Protection Association, Publication Department, 470 Atlantic Avenue, Boston, MA 02210, Phone 617/482-8755. Most of the procedures outlined in this package would also be applicable for fires involving transformers which contain PCBs.

6. A medical surveillance program should be implemented for all fire fighters. The program should include: (1) periodic assessment of cardiac and pulmonary function through medical histories, physical examinations, pulmonary function testing, electrocardiograms, and chest x-rays; (2) audiometric tests; and (3) vision testing. Fire fighters over forty years of age should be re-examined every year. Pulmonary function tests, audiometric, and eye tests are essential for the preplacement examinations in order to establish baselines to which subsequent tests can be compared. Special exams should be scheduled immediately after a fire when exposures to toxic substances are known or strongly suspected.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY

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

Copies of this report have been sent to:

1. Miami Association of Fire Fighters
2. International Association of Fire Fighters
3. City of Miami Fire Department
4. Florida Power and Light Company
5. U.S. Department of Labor, OSHA, Region IV
6. NIOSH Region IV
7. Designated State Agencies

For the purpose of informing the "affected employees", the employer will promptly "post" this report for a period of thirty (30) calendar days in a prominent place(s) near where the affected employees work.

XI. REFERENCES

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TABLE 1

PCB RESIDUE FROM TRANSFORMER VAULT FIRE
Collected April 16. 1982

Miami Fire Department
Miami, Florida
HETA 82-224

Sample Location/Description	Type Sample	PCBs* (ug/100 cm^2)
Inside Transformer Vault:		
wall behind removed transformer (soot)	swipe	434 **
top of primary cable above fire (soot)	swipe	389
primary cable support bracket (soot)	swipe	704
floor near base of isolating switch (dirt)	swipe	27400
ceiling near fire location (soot)	swipe	860
secondary bus near vault ceiling (dirt)	swipe	195
wall next to exit ladder (dust)	smear tab	2
rung of exit ladder (dust)	smear tab	79
Above Transformer Vault:		
sidewalk grating	smear tab	2
standing water at curb near vault	swipe	3
Firemen's Clothing and Equipment:		
sleeves of turnout coat No. 654	smear tab	<0.1
top of boot No. 654	smear tab	<0.1
inside helmet No. 133	smear tab	<0.1
front of turnout coat No. 133	smear tab	<0.1
inside helmet face shield No. 1053	smear tab	<0.1
outside facepiece of SCBA	smear tab	<0.2
smoke ejector fan	smear tab	>31
Normal PCB Background Contamination***	swipe	<0.5

ug/100 cm^2 = micrograms of PCBs/sample collected by wiping 100 (estimated) square centimeters of surface area

*As Aroclor 1260 (used as standard for quantitation of samples)
**As mixture of Aroclor 1254 (231 ug) + Aroclor 1260 (203 ug)
***As determined by previous NIOSH Health Hazard Evaluations

Notes:

Personal equipment assigned to badge No. 654 had not been cleaned or used since transformer fire.

Personal equipment assigned to badge No. 133 had not been cleaned and was worn one time since transformer fire.

Swipe samples were collected on sterile cotton pads soaked in n-hexane

Whatman brand smear tabs were dry (not soaked in n-haxane) when collecting samples

TABLE 2

RESULTS OF ANALYSES FOR POLYCHLORINATED DIBENZODIOXINS AND POLYCHLORINATED DIBENZOFURANS IN BULK SAMPLES OF RESIDUE FROM TRANSFORMER VAULT FIRE

Collected April 16, 1982

Miami Fire Department
Miami, Florida
HETA 82-224

PCDD Isomers	Number Possible	Number Detected						Concentration In Sample					
Samples:		B1	B2	B3	B4	B5	B6	B1	B2	B3	B4	B5	B6
Mono CDD	2	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Di CDD	10	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Tri CDD	14	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Tetra CDD	22	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Penta CDD	14	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Hexa CDD	10	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Hepta CDD	2	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Octa CDD	1	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
2,3,7,8-TCDD	1	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND

Sample Description/Location:

B1	Soot, dust, and dirt from top of primary cable support bracket, circuit # 2
B2	residue from floor under isolating switch near burned transformer
B3	Scrapings from ceiling above transformer
B4	Scrapings from secondary bus
B5	Vault wall near exit ladder
B6	Scrapings of soot and dirt from smoke ejector fan used to exhaust smoke from vault during fire

ND = Not Detected
Detection Limit = 10 nanograms/gram (ng/g) for samples B1, B5 and B6
= 100 ng/g for sample B2, B3 and B4

TABLE 2

RESULTS OF ANALYSES FOR POLYCHLORINATED DIBENZODIOXINS AND POLYCHLORINATED DIBENZOFURANS IN BULK SAMPLES OF RESIDUE FROM TRANSFORMER VAULT FIRE

Collected April 19, 1982

Miami Fire Department
Miami, Florida
HETA 82-224

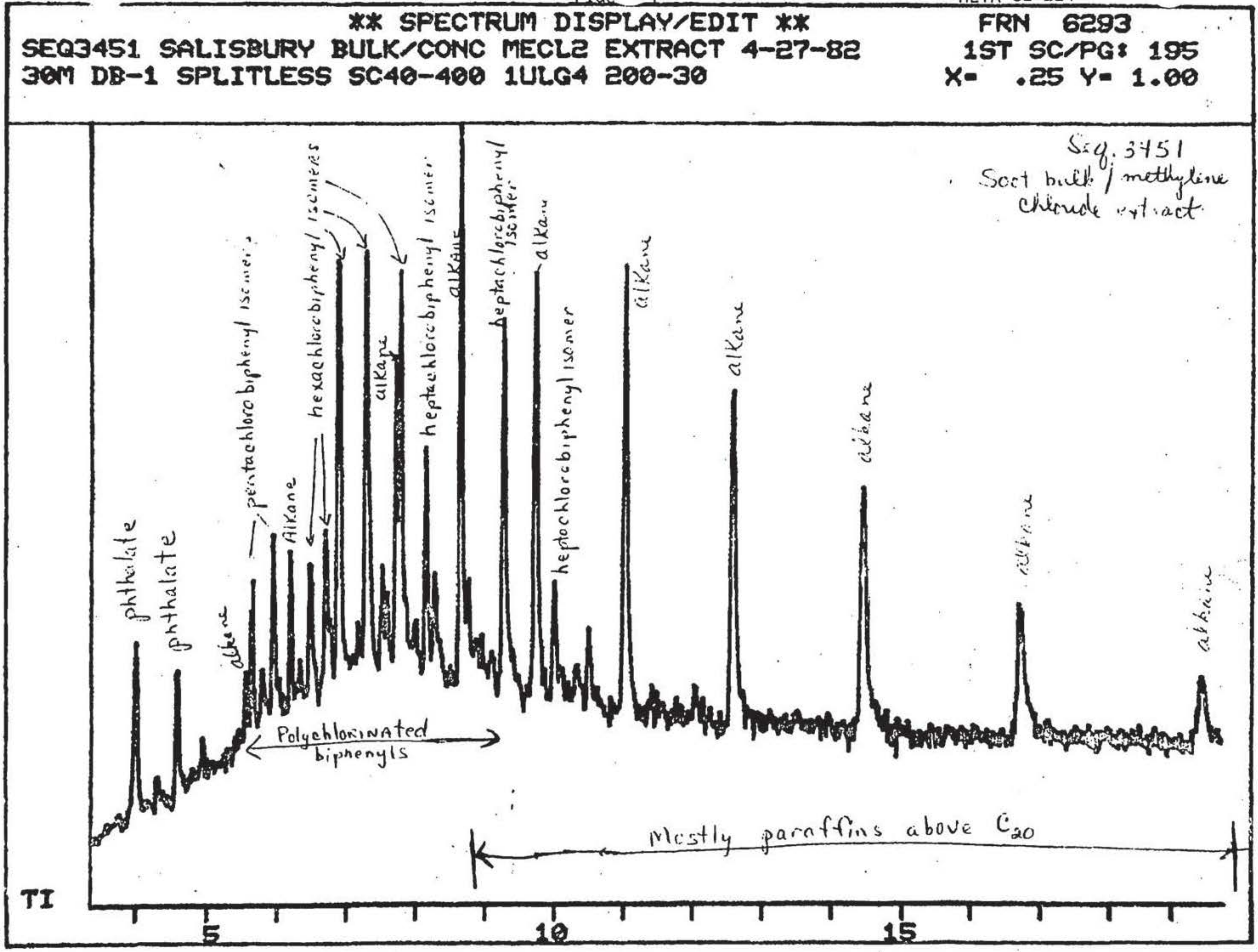
PCDF Isomers		Number Possible	Number Detected						Concentration In Sample					
Samples:			B1	B2	B3	B4	B5	B6	B1	B2	B3	B4	B5	B6
Mono	CDF	4	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Di	CDF	16	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Tri	CDF	28	6	0	0	0	0	6	180 ng/g	ND	ND	ND	ND	110 ng/g
Tetra	CDF	38	6	0	0	0	0	7	530 ng/g	ND	ND	ND	ND	280 ng/g
Penta	CDF	28	7	0	0	0	0	5	1000 ng/g	ND	ND	ND	ND	290 ng/g
Hexa	CDF	16	3	0	0	0	0	4	180 ng/g	ND	ND	ND	ND	100 ng/g
Hepta	CDF	4	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Octa	CDF	1	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
2,3,7,8-TCDF		1	0	0	0	0	0	0	ND	ND	ND	ND	ND	ND
Total PCDFs									1890 ng/g (1.89 ug/g)					780 ng/g (0.78 ug/g)

Sample Description/Location:

B1	Soot, dust, and dirt from top of primary cable support bracket, circuit # 2
B2	residue from floor under isolating switch near burned transformer
B3	Scrapings from ceiling above transformer
B4	Scrapings from secondary bus
B5	Vault wall near exit ladder
B6	Scrapings of soot and dirt from smoke ejector fan used to exhaust smoke from vault during fire

ND = Not Detected
Detection Limit = 10 nanograms/gram (ng/g) for samples B1, B2, B5, and B6
= 50 ng/g for sample B4
= 100 ng/g for sample B3

FIG 1



```
** SPECTRUM DISPLAY/EDIT **                                 FRN  6293
SEQ3451 SALISBURY BULK/CONC MECL2 EXTRACT 4-27-82      1ST SC/PG: 195
30M DB-1 SPLITLESS SC40-400 1ULG4 200-30              X=  .25 Y= 1.00
```

Seq. 3451
Soot bulk / methylene chloride extract

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
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