INDUSTRIAL HYGIENE SURVEY OF THI

General Electric Company
Hudson Falls, New York
Fort Edward, New York

SURVEY DATE

June 21-28, 1976
April 27-28, 1977

SURVEY CONDUCTED BY

Mark Jones
Robert Phillips
Tom Sandusky
Janson Becker
Tom Fogarty
Leo Blade
Dave Marlow

REPORT WRITTEN BY

Mark Jones

DATE OF REPORT

January 6, 1978

Industrial Hygiene Section
Industrywide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio

PLACE VISITED:	General Electric Company Hudson Falls, New York Ft. Edward, New York
DATES OF VISIT:	June 21-28, 1977 April 27-28, 1977
PERSONS MAKING VISIT:	Mark Jones, NIOSH Robert Phillips, NIOSH Tom Sandusky, NIOSH Janson Becker, NIOSH Tom Fogarty, NIOSH Leo Blade, NIOSH Dave Marlow, NIOSH
PERSONS CONTACTED:	Mr. J. Moss Safety Supervisor Mr. O. White, Jr. Chemist - Pollution - Environmental Hygiene Mr. G. Chandler Manager - Treat Operation Hudson Falls Mr. F. Gibson Foreman - Treat Operation Hudson Falls Mr. T. Hiedorf Foreman - Treat Operation in 1st Shift Ft. Edward Mr. D. Clifford Foreman - Treat Operation 2nd Shift Ft. Edward
UNION:	United Electrical, Radio and Machine Workers of America, Local #332
PURPOSE:	To conduct an industrial hygiene study of the capacitor production areas in which polychlorinated biphenyl is used and their adjacent operations.

INTRODUCTION

The Division of Surveillance, Hazard Evaluations and Field Studies of the National Institute for Occupational Safety and Health has underway an industrial hygiene/epidemiological study to determine the health effects on workers exposed to polychlorinated biphenyls.

As the result of a walk-through survey conducted by Leela Murthy, David Brown and Mark Jones at the General Electric facilities in Hudson Falls and Ft. Edward, New York on January 20, 1976, it was decided to conduct a thorough study of these facilities. This survey was conducted by Mark Jones, Robert Phillips, Tom Sandusky and Janson Becker during July 21-28, 1976. However, due to problems in the sampling procedure and analytical method a follow-up survey was conducted on April 27-28, 1977 by Mark Jones, Tom Fogarty, Leo Blade and Dave Marlow.

During the survey air samples were collected to determine air concentration of polychlorinated biphenyls, lead, tin, zinc, toluene, methyl isobutyl ketone, trichloroethylene, aluminum and iron.

DESCRIPTION OF FACILITIES

The Ft. Edward and Hudson Falls facilities are located about one mile apart along the Hudson River in New York. The Ft. Edward plant began operations using polychlorinated biphenyls in 1946 and the Hudson Falls plant in 1951. Today the Ft. Edward plant primarily manufactures small capacitors used in lighting, air conditioning, etc. while the Hudson Falls plant manufactures power capacitors. Currently, the polychlorinated biphenyl being used is Monsanto's Aroclor 1016 with occasional use of Aroclor 1221. In past years both Aroclor 1254 and Aroclor 1242 have been used. Other materials used are mineral oil, dibutyl sebacate, dioctyl phthalate and some stabilizers.

Presently both plants hire a total of approximately 1400 employees. There are approximately 233 hourly employees at Hudson Falls and approximately 700 hourly employees at Fort Edward. The work force is predominantly white and equally distributed between male and female. The union at these plants is Local #332 of United Electrical, Radio and Machine Workers of America.

MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

Dr. Feingold is the physician retained by the plants on a part-time basis. There are also two nurses employed at the plants.

All employees must take a pre-employment examination. Those employees who are exposed to hazardous material (PCBs, lead, and trichloroethylene) are given periodic examinations which include chest x-rays, blood test,

EKG, and pulmonary function. The plant has started a hearing conservation program in which audiometric tests will be given annually.

Mr. James Moss is the Safety Supervisor at these facilities. The facilities have initiated new safety practices. In the past, gloves, aprons, safety glasses, and shoes were supplied to the employees by the company. Instead of gloves, some of the employees chose to use a barrier cream, Milburn ply-9, which is made from wood pulp and designed specifically for use with PCBs. The present program consists of providing longsleeve coveralls, liquid-proof aprons, safety shoes and safety glasses on a full time basis. Respirators, full face shields and earplugs are provided where necessary. All clothing and materials are cleaned at the plant.

Air samples have been taken for PCBs at the facilites by OSHA regional personnel. Both AA millipore filters and charcoal tubes were used to collect the samples.

DESCRIPTION OF THE PROCESSES

Hudson Falls

The plant at Hudson Falls is mainly involved in the manufacturing of large capacitors. First, bales of paper, film, and foil are rolled together automatically. A number of these rolls are covered with cardboard, bound together and tested automatically. This is called the capacitor pack. Next, the proper leads are assembled and connected and the capacitor pack is inserted into the metal capacitor box. The capacitor unit is then tested in a vacuum to check for leaks. From here the majority of the capacitors are filled automatically in a closed system but some are still flood filled in chambers.

The flood filled capacitors are put into a chamber, heated and then put under vacuum to remove any moisture that is present. The polychlorinated biphenyls are then pumped from storage tanks outside the building into the chamber. The residue PCBs are then pumped out of the chamber, filtered, and reused.

During the closed system operation the PCBs are pumped into the capacitor through a valve in the top of the capacitor. When the capacitor is filled, the valve is removed manually and the top of the capacitor cleaned of any excess PCBs. The hole is then soldered to seal the capacitor.

Next, the capacitor is put into the "heat soak", which causes the oil to penetrate the bales.

The capacitor is then tested and if there are no leaks, is sent through a trichloroethylene degreaser. Then the capacitor is painted, dried, and packed for shipping.

Ft. Edward

The plant at Ft. Edward mainly produces the smaller capacitors that are used in lighting and air conditioning. First, webs of either paper, film, and foil or film and foil are rolled together automatically. While this is being done, the capacitor cases and tops are manufactured and cleaned in trichloroethylene degreasers.

Next, the capacitor is assembled. This includes inserting the roll into the capacitor can, making the correct connections between the roll and the capacitor top and finally sealing the capacitor top to the capacitor box.

The capacitor is then put into the treat system (either a carrousel or chamber). In these systems the capacitor is automatically heated, put under vacuum and filled with the dielectric fluid (mainly polychlorinated biphenyls).

From the treat system the capacitor went to the crimping operation (no longer used) or soldering operation where it is sealed. Next, the capacitor is washed with heated water and phosphates, tested for leaks and packed for shipping.

At these plants, waste polychlorinated biphenyls or other materials contaminated with it are disposed of into drums which are shipped to a licensed incinerator in Buffalo, New York.

INSPECTION OF PLANT

Potential Health Hazards

Potential health hazards observed during this survey were as follows:

Ft. Edward

Hazard	Location	# of Workers Exposed
PCBs	Impregnation Soldering, Testing Maintenance	~110
Trichloroethylene	Degreasers	5
Toluene, MIBK	Painting	3
Lead, Zinc, Tin	Soldering	10

Hudson Falls

Hazard	Location	# of Workers Exposed
PCBs	Impregnation Rework & Repair	25
Trichloroethylene	Degreaser	5
Toluene, MIBK	Painting	3
Aluminum, Iron	Welding	4
Lead, Tin, Zinc	Soldering	6

Ventilation

During the period between the two surveys a great amount of new ventilation was built in the facility. This helped to reduce the levels of exposures found. Many areas where PCBs were present are now equipped with local exhaust ventilation.

Housekeeping

The floors seemed to be slippery even after being cleaned by the vacuum scrubber. Otherwise work areas were kept fairly clean.

SURVEY PROCEDURES

General

Air samples were collected in this plant for evaluating exposure to polychlorinated biphenyls, trichloroethylene, toluene, methyl isobutyl ketone, lead, zinc, tin, aluminum and iron. The following paragraphs describe the methods used to collect and analyze the air samples.

Polychlorinated Biphenyls

Both personal and area air samples were collected in the treatment area and adjacent operations. The Sipin SP1, DuPont 200 and MDA Accuhaler 808 pumps were used to collect the air samples on florosil tubes. The tubes contain an absorbing material (magnesium silicate) called florosil and have a 100 mg primary section and a 50 mg backup section. Samples were collected from two to seven hours at flow rates varying from 50 to 200 cc/min. The polychlorinated biphenyl was desorbed from the florosil by using benzene and analyzed with a gas chromatograph equipped with an electron capture detector.

Trichloroethylene, Toluene and MIBK

Air samples were collected for trichloroethylene near the degreasing operations and for toluene and MIBK during painting operations. MDA Accuhaler 808 pumps were used to collect the air samples in tubes containing an activated charcoal absorbent. The tubes have a 100 mg primary section and 50 mg backup section. Samples were collected from two to four hours at a flow rate of approximately 50 cc/min. The samples were desorbed with carbon disulfide and analyzed with a gas chromatograph.

Lead, Zinc, Iron and Aluminum

Lead and zinc area air samples were collected during soldering operations and iron and aluminum area air samples during welding operations. MSA Model G pumps were used to collect the air samples on 37mm/0.8 micrometer mixed cellulose ester membrane filter. The samples were collected for approximately two to three hours at a flow rate of 1.5 ℓpm. The samples were digested in nitric acid and analyzed by atomic absorption.

Tin

Air samples were collected for tin during soldering operations. MSA Model G pumps were used to collect the air samples on 37mm/0.8 micrometer mixed cellulose ester membrane filters. The sample was collected for approximately three hours at a flow rate of 1.5 ℓpm. The samples were ashed with nitric and sulfuric acid and analyzed by atomic absorption.

RESULTS AND DISCUSSION

Polychlorinated Biphenyls

The results of the area and personal air samples are given in Tables I and II and job description in Appendix A. The concentrations found at the Ft. Edward facility were higher than those found at the Hudson Falls facility. There were 12 personal and eight area samples collected at Hudson Falls. The personal air samples at Hudson Falls ranged from 50 $\mu g/m^3$ (Repairman) to 316 $\mu g/m^3$ (Recovery & Repair). The air area samples ranged from 3 $\mu g/m^3$ (Winding) to 52 $\mu g/m^3$ (Test and Paint).

There were 19 personal and 13 area air samples collected at Ft. Edward. The personal air samples at Ft. Edward ranged from 116 $\mu g/m^3$ (Treat Operator) to 396 $\mu g/m^3$ (Moveman - Sealing). The area air samples ranged from 9 $\mu g/m^3$ (Shipping) to 564 $\mu g/m^3$ (Soldering).

Trichloroethylene

The results of the area air samples collected for trichloroethylene are presented in Tables III A and B. Eleven samples were collected at degreasing operations at both plants.

At the Ft. Edward plant one sample found a concentration of 195 ppm but all others were below 35 ppm while at the Hudson Falls plant one sample found a concentration of 321 ppm but all others were below 25 ppm.

Toluene and MIBK

The results of the personal air samples collected during painting operations at both plants is presented in Tables IV A and B. Twelve samples were collected for determination of toluene and MIBK. No detectable levels of MIBK were found at the Hudson Falls plant while two samples found toluene concentrations 0.48 and 0.53 ppm. Toluene concentrations ranging from 10 to 22 ppm and MIBK concentrations ranging from 2 to 5 ppm were found at the Ft. Edward plant.

Lead and Zinc

The results of the area air samples collected for lead and zinc are presented in Table V. Four air samples were collected during the soldering operations at Ft. Edward. Lead was detected on only one sample at a level of 12 $\mu g/m^3$. Zinc was detected on two samples at levels of 8 and 24 $\mu g/m^3$.

Aluminum and Iron

The results of the aluminum and iron samples collected during welding operations at Hudson Falls are presented in Table VI. Three personal samples were collected for the determination of aluminum concentrations while 3 personal and 1 area air samples were collected for the determination of iron concentrations. The aluminum samples ranged from non-detectable (limit of detection 5.0 μg/tube) to 233 $\mu g/m^3$ and the iron samples from 47 $\mu g/m^3$ to 123 $\mu g/m^3$.

Tin

No detectable levels (80 μg/tube) of tin were found.

Polychlorinated Biphenyls

The current OSHA Standard and ACGIH TLV for chlorodiphenyl (42% chlorine) is 1000 $\mu g/m^3$ (1 mg/m^3).

The dermatological effect and systemic effect on the liver of polychlorinated biphenyls are well reported in the literature; however, recent literature has linked possible carcinogenic effects to polychlorinated biphenyls.[1,2,3] Therefore, this standard may not adequately protect the workers health.

Trichloroethylene

The current OSHA standard for trichloroethylene is 100 ppm based on a 8 hour time weighted average. The NIOSH recommended standard and ACGIH TLV are also set at this level.

The health effects that have been associated with occupational exposure to trichloroethylene are depression of the central nervous system, cardiovascular changes and effects on the liver, kidneys and skin.[4] However, trichloroethylene has been associated with carcinogenesis in mice as reported by the National Cancer Institute.[5]

Toluene

The current OSHA standard for toluene is 200 ppm. The NIOSH recommended standard and ACGIH TLV are 100 ppm.

MIBK

The current OSHA standard and ACGIH TLV for MIBK is 100 ppm.

Lead

The current OSHA standard for lead is 200 $\mu g/m^3$. There is a proposed OSHA standard of 100 $\mu g/m^3$. The NIOSH recommended standard and ACGIH TLV is 150 $\mu g/m^3$.

Zinc

The current OSHA standard for zinc oxide (reported as zinc) is 5 mg/m^3 (5000 $\mu g/m^3$). The NIOSH recommended standard and ACGIH TLV is also 5 mg/m^3.

Aluminum

Currently there is no OSHA standard for aluminum but the ACGIH TLV for aluminum (Al_2O_3) is 10 mg/m^3.

Iron

The current OSHA standard for iron oxide (measured as iron) is 10 mg/m^3 while the ACGIH TLV is 5 mg/m^3.

CONCLUSIONS AND RECOMMENDATIONS

Based on observations made during this survey, the following conclusions are drawn and recommendations for improvements made. The author realizes that this operation is discontinuing the use of PCBs but this recommendation will help limit occupational exposure to any capacitor fluid which is used.

1) The additions to the ventilation system constructed between visits has improved the working environment and decreased exposures to PCBs. However, PCBs concentrations can still be found throughout both plants. Most of this contamination is probably coming from the impregnation, soldering, and repair operations. Therefore, it could help limit exposure where if these operations were separated from the other operations and had their own ventilation system. It would also help if these areas were put under negative ventilation to prevent escape of air contaminants from the areas.

2) Most of the samples collected during the degreasing operation were well below the current OSHA standard of 100 ppm for trichloroethylene. However, two samples were well over this level. This was probably due to either poor work practices or the degreasers being used more during these two sampling periods. I suggest that this situation be investigated to determine which is the case. Then correct the problem by enforcing better work practices or using engineering controls to prevent the vapors from escaping the degreaser.

Appendix A

JOB DESCRIPTIONS

Hudson Falls

Treat Operator - checks chambers where capacitors are located.

Treat Helper - helps move capacitors out of heat chambers and moves them to where they are filled, helps treat operator.

EMF Operator - puts on valve which is used to fill capacitors and then fills the capacitor.

Repair and Seal - solders the capacitor shut when the filling valve is removed.

Moveman - moves capacitors and materials from one operation to the next.

Recovery, Repair and Salvage - works on capacitors that do not pass inspection.

Ft. Edward

Treat Operator - in charge of the impregnation chambers where the capacitors are flood filled.

Tester - loads capacitors on conveyor system which moves them to the testing machine.

Packer - loads capacitors into boxes after they have been tested.

Rework - try to determine where leaks are on capacitors that have failed.

Final Assembly - Stamp, label and pack capacitors for shipping.

Moveman - works throughout plant moving capacitors and materials from impregnation chambers.

Crimper - sealed capacitor with rubber plug when it came from inpregnation chambers.

TABLE I

Concentrations of Polychlorinated Biphenyls Found at the
General Electric Facility in Hudson Falls, New York, on April 27-28, 1977

Personal Air Samples

Job Title	Date	Total Sampling Time (min.)	Total Volume (liters)	Concentration $\mu g/m^3$
Treat Operator	4/27	427	82.3	55
"	4/28	304	56.2	81
Treat Helper	4/27	426	67.0	75
"	4/28	441	95.1	84
Recovery & Repair	4/27	422	84.5	281
"	4/28	418	80.9	316
Repair & Seal	4/27	119*	23.8	201
"	4/28	254*	56.9	136
EHF Operator	4/27	431	65.3	115
"	4/28	176*	35.2	171
Repair	4/27	422	89.0	50
Salvage Operator	4/28	426	31.0	155

*Based on known sample volume and approximate flow rate

TABLE I (continued)

Area Air Samples

Location	Date	Total Sampling Time (min.)	Total Volume (liters)	Concentration $\mu g/m^3$
Winding	4/27	195*	38.9	43
"	4/28	420	62.9	3
Test & Paint	4/27	423	75.1	52
"	4/28	417	84.7	30
Assembly	4/27	426	84.1	33
"	4/28	425	86.2	24
Shipping	4/27	426	82.7	16
Storage	4/28	427	85.2	14

TABLE II

Concentrations of Polychlorinated Biphenyls Found at the
General Electric Facility in Ft. Edward, New York on April 27-28, 1977

Personal Air Samples

Job Title	Date	Total Sampling Time (min.)	Total Volume (liters)	Concentration $\mu g/m^3$
Treat Operator	4/27	414	100.4	116
"	4/28	431	28.1	203
Maintenance	4/27	404	82.7	150
Tester	4/28	440	63.8	264
"	4/27	427	83.6	226
"	4/27	423	83.5	161
Packer	4/28	434	57.1	256
"	4/27	428	81.9	166
"	4/27	425	69.3	175
Rework & Final Assembly	4/27	411	84.3	130
"	4/27	413	79.5	174
Rework Packer	4/28	435	60.9	132
Rework Tester	4/28	433	53.1	140
Rework & Tester Solder	4/28	271	38.7	241
Hoveman (Testing & Soldering)	4/28	439	56.6	303
"	4/27	415	84.7	173
"	4/28	452	24.5	183
Hoveman (sealing	4/28	432	24.3	396
"	4/27	257	51.5	389

TABLE II (continued)

Area Air Samples

Location	Date	Total Sampling Time (min.)	Total Volume (liters)	Concentration $\mu g/m^3$
Final Assembly	4/28	423	83.9	111
"	4/28	410*	82.0	134
"	4/27	404	82.2	119
Soldering	4/28	398	58.2	392
"	4/27	384	53.9	564
Winding	4/28	441	83.8	54
"	4/27	387	75.1	53
Shipping	4/28	428	61.6	101
"	4/28	410	81.1	9
Can Mfg.	4/28	437	78.7	36
"	4/27	399	82.3	67
Cover Mfg.	4/28	442	72.6	62
"	4/27	392	75.1	25

TABLE IIIA

Concentrations of Trichloroehtylene Found at the
General Electric Facility in Ft. Edward, New York on April 27-28, 1977

Location	Date	Total Sampling Time (min.)	Total Volume (liters)	Concentration $\mu g/m^3$
Degreaser (near soldering)	4/28	149	7.28	3.7
"	4/28	174	11.4	14.9
"	4/27	154	7.37	195*
"	4/27	171	8.34	34.0

*tube was saturated

TABLE IIIB

Concentrations of Trichloroethylene Found at the
General Electric Facility in Hudson Falls, New York on April 27-28, 1977

Job Title	Date	Total Sampling Time (min.)	Total Volume (liters)	Concentrations $\mu g/m^3$
Degreaser 3rd Floor (near painting area)	4/27	185	9.38	24.3
"	4/27	214	10.6	6.6
"	4/28	210	10.8	5.8
"	4/28	196	10.2	5.9
Degreaser 1st Floor (near EMF Op.)	4/28	189	9.61	1.5
"	4/28	190	10.2	321*
"	4/27	185	9.88	N.D.**
"	4/27	202		

*tube was saturated
**N.D. Non-Detectable (limit of detection 0.01 mg/tube)

TABLE IVA

Concentrations of Toluene and Methyl Isobutyl Ketone Found at the General Electric Facility in Ft. Edward, New York, on April 27-28, 1977

Job Title	Date	Total Sampling Time (min.)	Total Volume (liters)	Toluene Concentration ppm	MIBK Concentration ppm
Painter	4/28	144	7.69	2.8	2.2
"	4/28	234	12.2	5.6	5.0
"	4/27	153	6.02	5.7	4.9
"	4/27	163	3.27	4.9	5.2

TABLE IVB

Concentrations of Toluene and Methyl Isobutyl Ketone Found at the General Electric Facility in Hudson Falls, New York on April 27-28, 1977

Job Title	Date	Total Sampling Time (min.)	Total Volume (liters)	Toluene Concentration ppm	MIBK Concentration ppm
Painter	4/27	199	9.77	N.D.*	N.D.*
"	4/28	189	11.0	N.D.	N.D.
"	4/28	215	11.0	.48	N.D.
"	4/27	206	10.0	.53	N.D.
Label & Packer	4/28	258	12.7	N.D.	N.D.
"	4/28	145	7.11	N.D.	N.D.
"	4/27	204	11.0	N.D.	N.D.
"	4/27	199	10.9	N.D.	N.D.

*N.D. - Non-Detectable (limit of detection 0.01 mg/tube)

TABLE V

Concentrations of Zinc and Lead Found at the
General Electric Facility in Ft. Edward, New York on April 27-28, 1977

Area	Date	Total Sampling Time (min.)	Total Volume (liters)	Zinc Concentration ($\mu g/m^3$)	Lead Concentration ($\mu g/m^3$)
Soldering	4/27	185	277.5	N.D.*	N.D.**
"	4/28	167	250.5	8	12
"	4/27	164	246	N.D.	N.D.
"	4/28	166	249	24	N.D.

*N.D. - Non-Detectable (limit of detection 1.0µg)

**N.D. - Non-Detectable (limit of detection - 2.0µg)

TABLE VI

Concentrations of Aluminum and Iron Found at the General Electric Facility in Hudson Falls, New York on April 27-28, 1977

Job Title	Date	Total Sampling Time (min.)	Total Volume (liters)	Aluminum Concentration ($\mu g/m^3$)	Iron Concentration ($\mu g/m^3$)
Welder	4/28	120	180	233	
"	4/28	191	286.5	112	
"	4/27	133		N.D.*	
"	4/27	131	196.5		47
"	4/28	190	285		123
"	4/28	181	271.5		52
--	4/27	129	193.5		48

*N.D. - Non-Detectable (limit of detection 5.0µg)

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