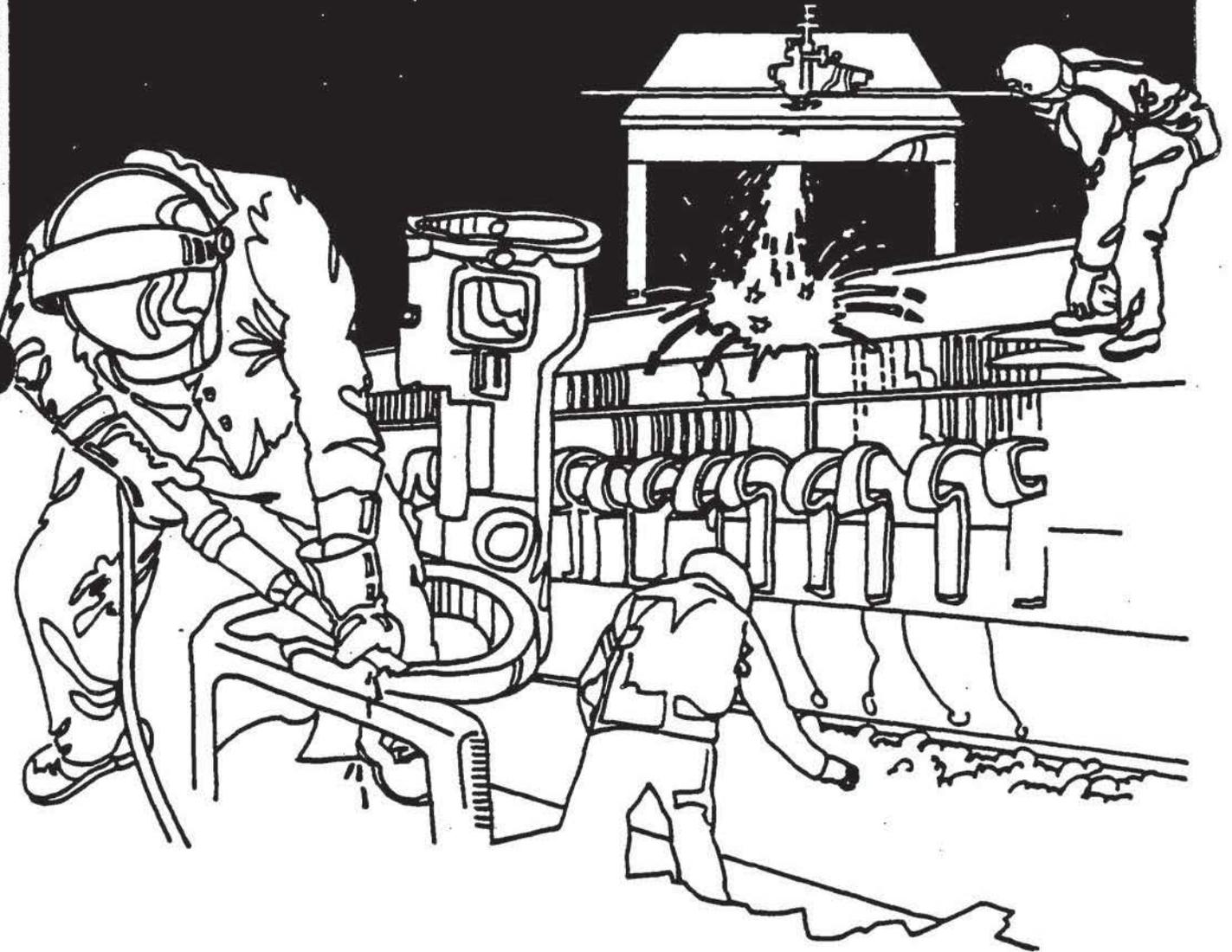


# NIOSH



## Health Hazard Evaluation Report

HETA 83-329-1498  
SOUTHERN BELL  
ATLANTA, GEORGIA

## 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 83-329-1498  
AUGUST 1984  
SOUTHERN BELL  
ATLANTA, GEORGIA

NIOSH INVESTIGATORS:  
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I. SUMMARY

On June 23, 1983, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate the frequency and etiology of spontaneous abortions among employees of Southern Bell's central computer facility in Atlanta, Georgia. Three miscarriages had been reported among computer attendants in a one and a half month period, and a cafeteria worker had died during surgery to remove her dead fetus.

On September 29-30, 1983, NIOSH investigators conducted a walk-through survey of the facility and interviewed 93 female employees. An additional five workers were interviewed by telephone. On November 2, a second visit was made to Southern Bell to conduct environmental sampling for methyl ethyl ketone. Results from this sampling showed methyl ethyl ketone was not detected, while levels of 0.2 to 0.4 ppm of benzene and 40 to 80 mg/m<sup>3</sup> of petroleum distillates were detected.

The proportion of spontaneous abortions in pregnancies which occurred when employees were working in the support building (exposed or study group) was compared to that when they did not work in the support building (non-exposed or comparison group). On the 5th floor of Southern Bell's support building, six of 14 pregnancies resulted in miscarriages, 43%, while the normal proportion is 15 to 20%. There was no substantial maternal exposure to medications, radiography or maternal illness in the study group. Maternal age, VDT use and time spent standing were not associated with reproductive outcome. Women with miscarriages tended to clean tape drives, perform non-supervisory jobs, and smoke more than those women with normal births, but no agent was identified which could have caused these miscarriages.

Findings of NIOSH's investigation indicate that a statistically significant increase in spontaneous abortions had occurred among women working on the fifth floor, particularly in the Data Processing Center of Southern Bell. However, no etiologic agent was found. Although it can not be definitely ruled out, it appears unlikely that a health hazard exists at this facility.

KEYWORDS: SIC# 3661, miscarriages, video display terminals

## II. INTRODUCTION

On April 11, 1983, OSHA received a confidential report from an employee in Southern Bell's support building, in Atlanta, Georgia, of three miscarriages in one and a half months among computer attendants and the death of a cafeteria worker during surgery to remove her dead fetus. Although no agents known to cause adverse reproductive outcomes are used in the areas of concern, OSHA conducted industrial sampling on April 19, 21 and 26.

On June 23, 1983, OSHA requested that the National Institute for Occupational Safety and Health (NIOSH) provide technical assistance to investigate the nature and frequency of spontaneous abortions among these employees. On September 29-30, 1983, two NIOSH medical officers visited the facility and interviewed all female employees in three departments. In November 1983, an initial letter summarizing the investigation was sent to Southern Bell.

## III. BACKGROUND

Southern Bell has recently consolidated its main operations in Atlanta into a 54-story main building and a 7-story support building which opened in the spring of 1981. The cafeteria for both buildings is on the top of the support building (7th floor), the main computer facilities on the 5th and 6th floors, and a garage on the floors immediately below. The centralized processing center for data at Southern Bell, as well as the software support activity, are contained in this building.

The original areas of concern were two departments on the 5th floor, the Data Processing Center (DPC) and the Control Data Center II (CDC II). We were also able to interview workers on the 6th floor in the Control Data Center I (CDC I) who do comparable work. These departments house computer hardware including the main frame, tape drives and numerous disc drive units. Video display terminals (VDTs; also known as cathode ray tubes or CRTs) are located throughout the area and most of them are manufactured by Western Electric. The machinery on both these floors is in constant use and there is a policy of 97% "up" time regardless of personnel or mechanical problems.

The DPC and CDC I both have separate printing rooms, with impact printers located in all three departments. The DPC printers, located in the media room, are two Honeywell Page Printing Systems (PPS) which use dielectric paper and liquid toner carrier and concentrate. Each machine uses approximately one-half gallon of toner concentrate and three gallons of toner carrier per day. The dielectric paper is electrostatically charged during the printing process and the ink adheres to the areas of the paper subjected to the charge. CDC I has a IBM 3800 printer which uses a dry powder toner and developer.

Employees in these three departments work as supervisors, computer programmers or computer attendants. The majority of employees are female and work as computer attendants. Their jobs include filing and retrieval of tapes, cleaning tapes and tape drives, mounting tapes on tape drives, monitoring VDTs and printing output. Employees on the 2nd and 3rd shifts rotate between different areas on a biweekly schedule while 1st shift workers are assigned to one area.

Chemicals used in these operations include isopropyl alcohol to clean the tapes and tape drives, trichlorotrifluoroethane for tape drives, and Honeywell Black Toner Concentrate (ASTM D93) and Honeywell Toner Carrier (P9150) for the Honeywell Page Printing System in the DPC. A powdered toner is used for the printer in CDC I. OSHA measured 0.13 ppm of formaldehyde in the DPC media supply room but not in any other DPC area.

Anhydrous isopropyl alcohol is used to clean the tape heads twice per day. It takes 1 to 2 minutes to clean each head, with each employee cleaning 10 drives in DPC and approximately six drives in CDC II. Trichlorotrifluoroethane is used to clean 50 tape drives and is used for approximately a half hour twice daily in CDC II.

In the processes evaluated, potential exposure to toxic materials occurs when workers come in skin contact with the cleaning solvents and printing fluids or breathe in their vapors. The Honeywell PPS heats the printed paper to dry the print and a reclamation unit captures resulting vapors. With the exception of the media room in the DPC, there were no operations which could, under conditions observed, result in substantial inhalation exposure of the chemicals being used. Use of the tape drive cleaning substances, isopropyl alcohol and trichlorotrifluoroethane, may result in some skin absorption for the brief period of time they are used.

The use of VDTs outside the I/O area is intermittent and not characterized as data entry work. Rather, they are used by most individuals for a few hours per day to monitor the computers and issue instructions to the printers. Ionizing radiation measurements conducted by OSHA on April 21, 1983, around the front of the DPC VDTs showed no detectable amounts. On April 26, 1983, measurements were also taken around the four PICS/BARR machines. These are physically located in the DPC area although administratively under the CDC II section. These measurements also showed no detectable radiation.

The 5th floor is under positive pressure with leakage occurring around the stairwells and the elevator shafts. With two air handling units delivering 11,250 cfm each, it takes 93 minutes for every air change. Each unit draws 3,500 cfm of outside air and 7,750 cfm of return air

through the ceiling plenum, while 1,100 cfm is exhausted to the roof from the bathrooms. Above the DPC, the ceiling does not act as a return air plenum as originally designed due to the floor air-cooling units, each of which pulls 1,750 cfm. Instead, it is a source of supply air that consists of recirculated air from other rooms. There are dividers in the floor and the ceiling plenums. Honeywell recommends that each PPS be supplied with 150 cfm of fresh air, and there are two supply vents in the media room ceiling. The Material Data Safety Sheet for the Honeywell Toner Carrier advises a face velocity of 60 feet per minute in the vicinity of its use.

#### IV. EVALUATION DESIGN AND METHODS

##### A. Environmental

During NIOSH's investigation, OSHA conducted further testing for potential exposures in the media rooms for CDC I and DPC as well as in the printing area for CDC II. On November 2, 1983, a personal breathing zone sample was taken for the operator of the two Honeywell Page Printing machines in the DPC media room to evaluate exposure to methyl ethyl ketone. Environmental samples were taken at this location, next to the IBM 3800 printer in CDC I and near the impact printers in CDC II. These samples were also analyzed for benzene and petroleum distillates.

Samples were collected with charcoal and silica gel tubes using individually calibrated personal sampling pumps. Average flow rates and collection times were 107 cc/min for 85 minutes for the charcoal tubes, 52.5 cc/min for 90.5 minutes for the silica gel tubes and 54 cc/min for 79 minutes for the personal sample. The charcoal tube samples were analyzed for methyl ethyl ketone, benzene and petroleum distillates by gas liquid chromatography according to OSHA's method. The silica gel samples were analyzed for methyl ethyl ketone only. The limits of detection are 0.3 ppm, 0.1 ppm, and 20 mg/m<sup>3</sup>, respectively for a 10 liter sample.

The design plans for the ventilation system were obtained and air flow patterns on the 5th floor characterized.

##### B. Medical

In order to investigate the reported health problems, we designed a questionnaire to obtain information on each individual's occupational, reproductive and health history. Job assignments were collected from the department supervisor for employees working in DPC from May 1982 through June 1983.

The survey included all currently employed female workers present in DPC, CDC II and CDC I (6th floor) on September 29-30, 1983. All five former DPC workers were interviewed by phone. We compared the

proportion of spontaneous abortions (defined as miscarriages as a proportion of total pregnancies) which occurred when the employees were working in the support building (exposed or study group) to that when they did not work in the support building (non-exposed or comparison group). The study period began on March 1981 when the building opened.

V. EVALUATION CRITERIA

A. Environmental 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 (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. In reviewing the exposure levels and the recommendations for reducing those levels found in this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 to meet those levels specified by OSHA standards.

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.

B. Spontaneous Abortions

Spontaneous abortion (miscarriage) is a relatively common pregnancy outcome. The "expected" proportion among all live births in the U.S. general population is approximately 15% (12). In the first trimester, spontaneous abortion is associated with chromosomal abnormalities, which account for an estimated 50-60% of fetal loss (3). Most of these losses occur shortly after conception. In the second trimester, placental abnormalities, fetal malformation, poor maternal health and cervical incompetence are associated with fetal loss (13).

Both cigarette smoking and alcohol consumption have been shown to be risk factors for spontaneous abortions (16). The previously demonstrated association between increasing gravidity (pregnancy number) and increases in miscarriage rates is thought to be primarily due to a previous history of miscarriages and increasing maternal age (8).

C. Occupational Exposure and Spontaneous Abortions

The compositions of the cleaning and printing materials used in data processing at Southern Bell are listed in Table I. Also listed are exposures that were demonstrated around other Page Printing Systems in 1976 (Table IV). None of the chemicals listed have been shown to cause spontaneous abortions in humans, although one study has associated congenital central nervous system defects with organic solvent exposure during the first trimester of pregnancy (6). At least one investigator has concluded that the threshold limit values for some of these solvents should be lowered given that most standards were set only to prevent acute toxicity, not teratogenic or other reproductive outcomes (5).

Methyl ethyl ketone (MEK) has been demonstrated to be teratogenic in rats exposed to 3000 ppm for seven hours per day; (4 [19%] of 21 litters) (15). A similar study with a wider range of exposures did not find these effects (2). Toluene has been demonstrated to be embryotoxic (low fetal weights and retardation of fetal development) at doses of 399 and 266 ppm to mice and rats, and to increase the number of minor skeletal variants (7). Similar results were found in rats exposed to 313 ppm of benzene (7).

Shifts in organ weights of newborns were found when female rats inhaled 0.3 to 20 ppm of benzene and from formaldehyde at 0.01 to 0.8 ppm (4).

## VI. RESULTS

### A. Environmental

The media room has two Honeywell Page Printing Systems where detectable concentrations of various substances were measured. Neither the CDC I nor II printing areas had detectable levels of petroleum distillates or benzene. This is probably because both the toner and developer for the IBM 3800 printer in CDC I are dry powders, and CDC II has only impact printers. Personal samples in the DPC media room measured 40 mg/m<sup>3</sup> of petroleum distillates and 0.2 ppm benzene. Two area samples measured 80 and 40 mg/m<sup>3</sup> petroleum distillates and 0.3 and 0.4 ppm benzene.

MEK was not detected in any of the three departments. It had been used in the past as a solvent to apply a coat of resin to the dielectric paper in the Page Printing System which in 1976 resulted in detectable levels at other facilities (Table IV). The manufacturer replaced MEK with toluene about four to five years ago. This solvent-based paper was replaced in the summer of 1983 with a water based system from a different supplier.

### B. Medical

Three departments were investigated. Of the 139 female employees working in these areas, 123 (88%) were interviewed; 40 of 45 in the Data Processing Center, 43 of 50 in Control Data Center II, and 40 of 44 from Control Data Center I (6th floor).

Any woman with a history of medical complications during pregnancy was excluded from the analysis. One full-term stillbirth in the comparison group was counted as a normal birth since the outcome of interest is miscarriages at less than six months gestation. A stillbirth at five months gestation was, therefore, included as a miscarriage. One normal birth which occurred when the mother was working in the Support Building was grouped with the comparison pregnancies since she was four months pregnant when she began working in the Support Building. Induced abortions were excluded from the analysis.

One hundred and eighty-five pregnancies occurred while the women were not working in the support building and 26 (14%) of these resulted in miscarriages. Twenty-two pregnancies occurred while these women were working in the support building and seven (32%) of these resulted in miscarriages.

### Previous history

Previous reproductive history was not an important factor in this cohort. All except two of the normal births were either first births or were preceded by normal births. Of the seven women who had miscarriages, only one had a previous miscarriage, but she would not have been classified as a habitual aborter (i.e. a history of three or more miscarriages) (1). Among women in the support building, three of the five first pregnancies (60%) resulted in miscarriages. Of the nine non-first pregnancies, there were three miscarriages. In the comparison group, there was a low proportion of miscarriage among first pregnancies (10 of 88 first pregnancies, 11%).

### Departmental results

Combining the Data Processing Center and the Control Data Center II (the original areas of concern on the fifth floor), there were six miscarriages out of a total of 14 pregnancies (43%, see Table II). This is significantly greater than their comparison group's proportion of 13% (16 miscarriages out of 128 pregnancies,  $p = 0.009$ , one tailed Fisher's exact test).

In CDC I (on the 6th floor and not originally an area of concern), there were seven pregnancies and one miscarriage (13%). Before working at the West Peachtree facility these workers had 10 miscarriages out of 57 pregnancies (17%). Employees working in the Data Processing Center had four miscarriages (44%) among nine pregnancies compared to five miscarriages (8%) among 62 pregnancies in the DPC comparison group ( $p = 0.012$ , one tailed Fisher's exact test).

DPC has the clearest cluster in its temporal distribution (Figure 1). As mentioned earlier, one normal birth in the study group was counted in the comparison group since the mother was four months pregnant when she began working in the support building. If this birth is counted in the study group, and the stillbirth at nine months gestation is considered an adverse outcome, the statistical analysis is not significantly affected.

### Demographics and maternal exposures

There was no appreciable maternal exposure to medications, radiography or illness. Seventy-three percent (16 of 22) of the study population was black. Smoking during the pregnancy had a border line association with miscarriages ( $p = 0.055$ , one tailed Fisher's exact test) on the fifth floor but not when examining both floors together (Table III). There was a significant association between job title and pregnancy outcome (Table III,  $p = 0.009$ , one tailed Fisher's exact test) on the fifth floor but not on both

floors. All of the miscarriages on the fifth floor occurred among non-supervisory personnel. Paternal occupation or exposure to chemicals, as reported by the mother, did not appear to be an important factor since the fathers held a variety of jobs.

Video display terminals (VDTs), which can result in eye strain and musculoskeletal problems (14), have been a source of concern related to reports of adverse reproductive outcome among users (9,10,11). In this survey women having miscarriages and those reporting normal births reported comparable amounts of VDT use (Table III). The two groups were comparable with respect to age and time spent standing at work.

Tape drive cleaning was associated with miscarriages ( $p = 0.05$ , one tailed Fisher's exact test) on the fifth floor while borderline significant ( $p = 0.064$ ) on both floors. Neither chemical used in this operation has been reported to cause any adverse reproductive outcomes in either animal or human studies. Tape drive cleaning, unlike VDT usage, is mostly performed by computer attendants.

## VII. DISCUSSION

We did not find any associations that would explain this cluster. Maternal age, VDT use and time standing did not appear to be a contributing factor. The relationship found between gravidity and miscarriages is the reverse of what would be expected in this age group. The large demand for "up" time on the machinery, and consequently the workforce, may result in a significant stress problem. However, this would be expected to affect all floors equally.

Job title and cleaning tape drives were found to be associated with miscarriages on the fifth floor and all of the pregnancies among supervisory personnel on this floor resulted in normal births. This may suggest an association between spontaneous abortion and some factor related to job title, however, the limited information collected during interviews did not permit further assessment of these associations.

Small amounts of various solvents were found in and near the media room. Benzene and formaldehyde were detected here, while toluene was detected near other Page Printing Systems in 1976. Although there is evidence of embryotoxic effects in animal studies with each of these chemicals, it is unlikely they would have this effect at such low concentrations. Furthermore, the DPC work schedule of the four women who miscarried does not show any significant exposure to the media room.

No agent that would explain this clustering of events has been identified. However, the presence of formaldehyde, and the similar results for area and personal samples for petroleum distillates and benzene in the DPC, but not in the other areas, demonstrates the potential for contaminant generation in this area, as well as the lack of adequate environmental control. Given the environmental results obtained to date, the manufacturer's recommendations for the Toner Carrier, and the failure of the ceiling space to act as a return plenum, it would be prudent to minimize present and potential future exposures.

This cluster of spontaneous abortions could represent a chance occurrence. Given random variation and a sufficiently large number of groups of women working in similar environments around the country, some groups will have lower than expected rates while others will have higher rates of spontaneous abortions. This has been offered as an explanation for a previously reported miscarriage cluster (9). Despite the statistical "significance" between spontaneous abortions and employment on the fifth floor of the support building, in the absence of any etiological agent, we believe that chance occurrence is the most probable explanation for the cluster at Southern Bell.

A number of our findings appear to support this explanation. The 6th floor did not have an excess number of miscarriages. These workers perform similar work under comparable environmental conditions as the 5th floor workers. Those women who were computer attendants with Southern Bell before 1981 did not have an excess number of miscarriages (two out of 17 pregnancies). Assuming that these jobs were fairly comparable to the present ones, this tends to diminish the possibility that the cluster is work-related. Therefore, neither the overall building environmental conditions nor the job itself (working with computers) appear to be associated with miscarriages.

#### VIII. RECOMMENDATIONS

1. Protective gloves should be available to reduce skin contact with the cleaning and printing fluids.
2. A local exhaust system to capture any vapor from the Page Printing System should be installed. This should be exhausted to the roof and not recirculated into the present return air system.
3. Return air ducts should be constructed throughout the ceiling to ensure removal of air.

4. Administrative measures should be introduced so that any employee who has difficulty in loading the 50 pound rolls of paper for the page printing systems could request assistance. The present device assists in this operation but does not eliminate all potential problems.

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X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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Division of Surveillance, Hazard Evaluations, and Field Studies

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

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 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Communication Workers of America, Local 3204
2. Southern Bell
3. NIOSH, Region IV
4. OSHA, Region IV

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 I

Isopropyl Alcohol	Cleaning tapes and tape drives
Trichlorotrifluoroethane	Cleaning tape drives
Honeywell Toner Concentrate P-9101 - 100% Isopar L	DPC Honeywell Page Printing System
Honeywell Toner Carrier P-9150 - 75% Isopar L	DPC Honeywell Page Printing System

Isopar L  
(% by weight)

Iso-paraffins	99.6
Total Benzenes	.0336
Aromatics	.0045
Naphthalenes	.0008
Dinaphthenobenzene	.0004

TABLE II

Miscarriages / Total Pregnancies (Percentage)

DEPARTMENT	<u>COMPARISON GROUP</u> (Pregnancies before working at W. Peachtree)		<u>STUDY GROUP</u> (Pregnancies while working at W. Peachtree)	
Data Processing Center 5th floor	5/62	(8%)	4/9	(44%)
Control Data Center II 5th floor	11/66	(17%)	2/5	(40%)
Control Data Center I 6th floor	10/57	(18%)	1/8	(13%)
<hr/>				
Totals	26/185	(14%)	7/22	(32%)

TABLE III

STUDY GROUP  
Pregnancies while working at West Peachtree

	<u>Normal Births</u>		<u>Miscarriages</u>	
	<u>Both floors</u>	<u>5th floor</u>	<u>Both floors</u>	<u>5th floor</u>
<u>VDT usage</u>				
Mean VDT usage/ day (hrs)	4.3	2.9	4.4	3.8
<u>Time Standing</u>				
Mean time (hrs)	4.1	3.1	4.4	4.5
<u>Age</u>				
(years)	29.9	31.6	29.4	29.7

Miscarriages/Total Pregnancies  
(p = one sided Fisher's exact test)

	<u>Tape Drive Cleaning</u>	
	<u>Both floors</u>	<u>5th floor only</u>
<u>Cleaned drives</u>	5/9	5/7
<u>Did not clean drives</u>	2/13 p = 0.064	1/7 p = 0.05
	<u>Job Title</u>	
	<u>Both floors</u>	<u>5th floor only</u>
<u>Non supervisory</u>	6/14	6/8
<u>Supervisory</u>	1/8 p = 0.16	0/6 p = 0.009
	<u>Smoking Status</u>	
	<u>Both floors</u>	<u>5th floor only</u>
<u>Smoked during pregnancy</u>	3/5	3/3
<u>Did not smoke during pregnancy</u>	4/17 p = 0.15	3/11 p = 0.055

TABLE III (continued)

Miscarriages/Total Pregnancies  
(p = one sided Fisher's exact test)

	<u>Alcohol consumption</u>	
	<u>Both floors</u>	<u>5th floor only</u>
<u>Drank alcohol during pregnancy</u>	3/8	3/6
<u>Did not drink alcohol during pregnancy</u>	4/14	3/8

TABLE IV

CHEMICALS DETECTED IN VICINITY OF PAGE PRINTING SYSTEM (1)

CHEMICAL	TYPICAL (2)/HIGHEST LEVELS FOUND (ppm)
Isopar L	40 / 95 (3)
Methyl Ethyl Ketone	5 / 25
Toluene	0.3 / 2.4
Butyraldehyde	0.9 / 4.0
2-Ethyl-2-Hexenal	1.0 / 3.4

- (1) Data supplied by A. D. Little to Honeywell Information Services, Waltham, Massachusetts
- (2) Averages of measurements taken at four locations.
- (3) Measured at customer site with defective reclamation unit. This site measured 68 ppm after correction.

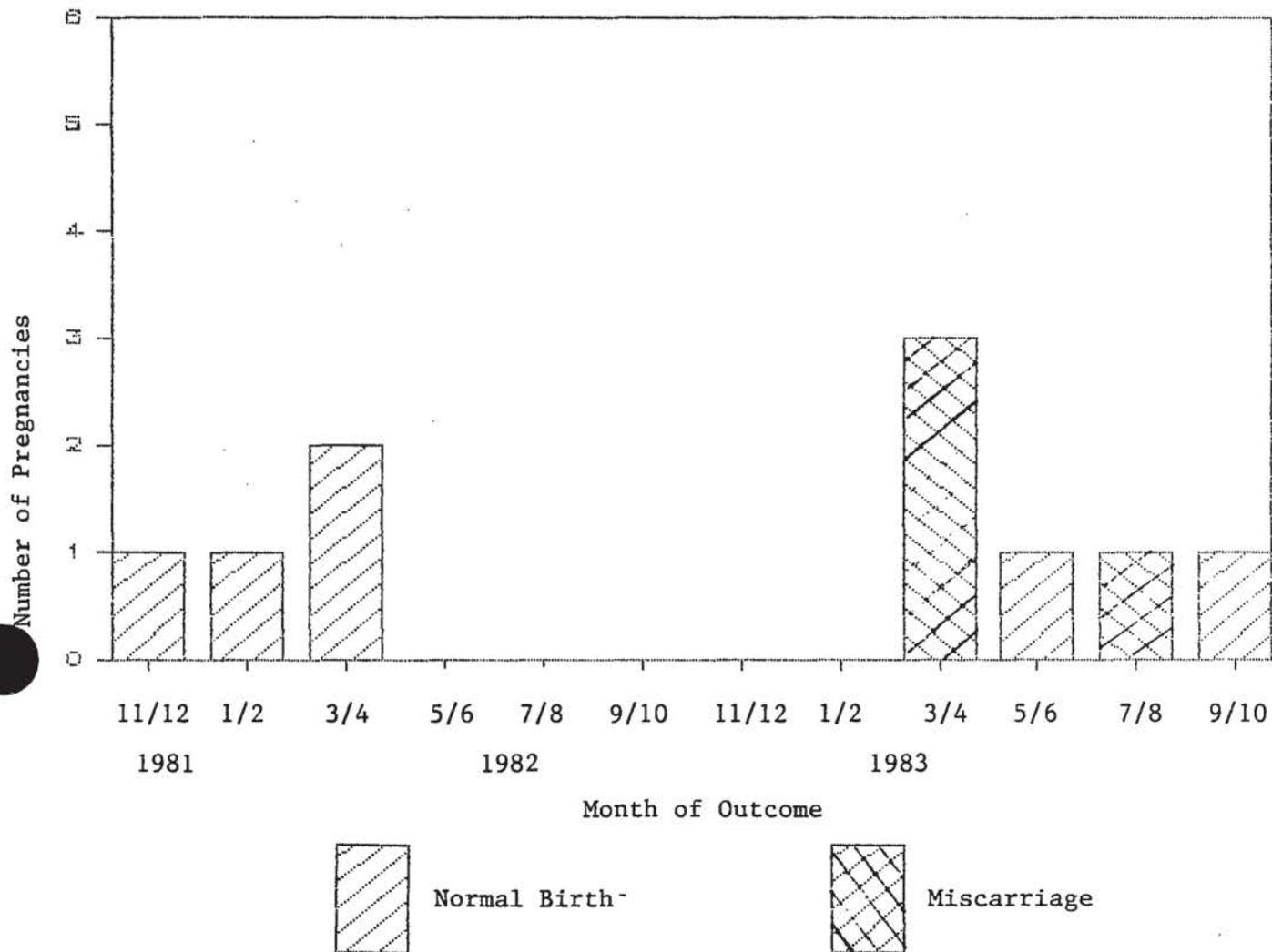
TABLE V  
ENVIRONMENTAL EVALUATION CRITERIA

<u>SUBSTANCE</u>	<u>SOURCE</u>	<u>PERMISSIBLE EXPOSURE LIMIT</u>	<u>CEILING LIMIT</u>	<u>PEAK</u>
Benzene	OSHA NIOSH	10 ppm	25 ppm 1 ppm	50 ppm *
2-Butanone (Methyl ethyl ketone)	OSHA NIOSH	200 ppm 200 ppm		
Formaldehyde	OSHA NIOSH	3 ppm	5 ppm 0.8 ppm	10 ppm
Petroleum distillates mixture (naphtha)	OSHA NIOSH	500 ppm 87 ppm		
Toluene	OSHA NIOSH	200 ppm 100 ppm	300 ppm 200 ppm	500 ppm

\* OSHA is presently preparing to promulgate a new benzene standard

FIGURE I

# Reproductive Outcome - DPC



DEPARTMENT OF HEALTH AND HUMAN SERVICES  
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CENTERS FOR DISEASE CONTROL  
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