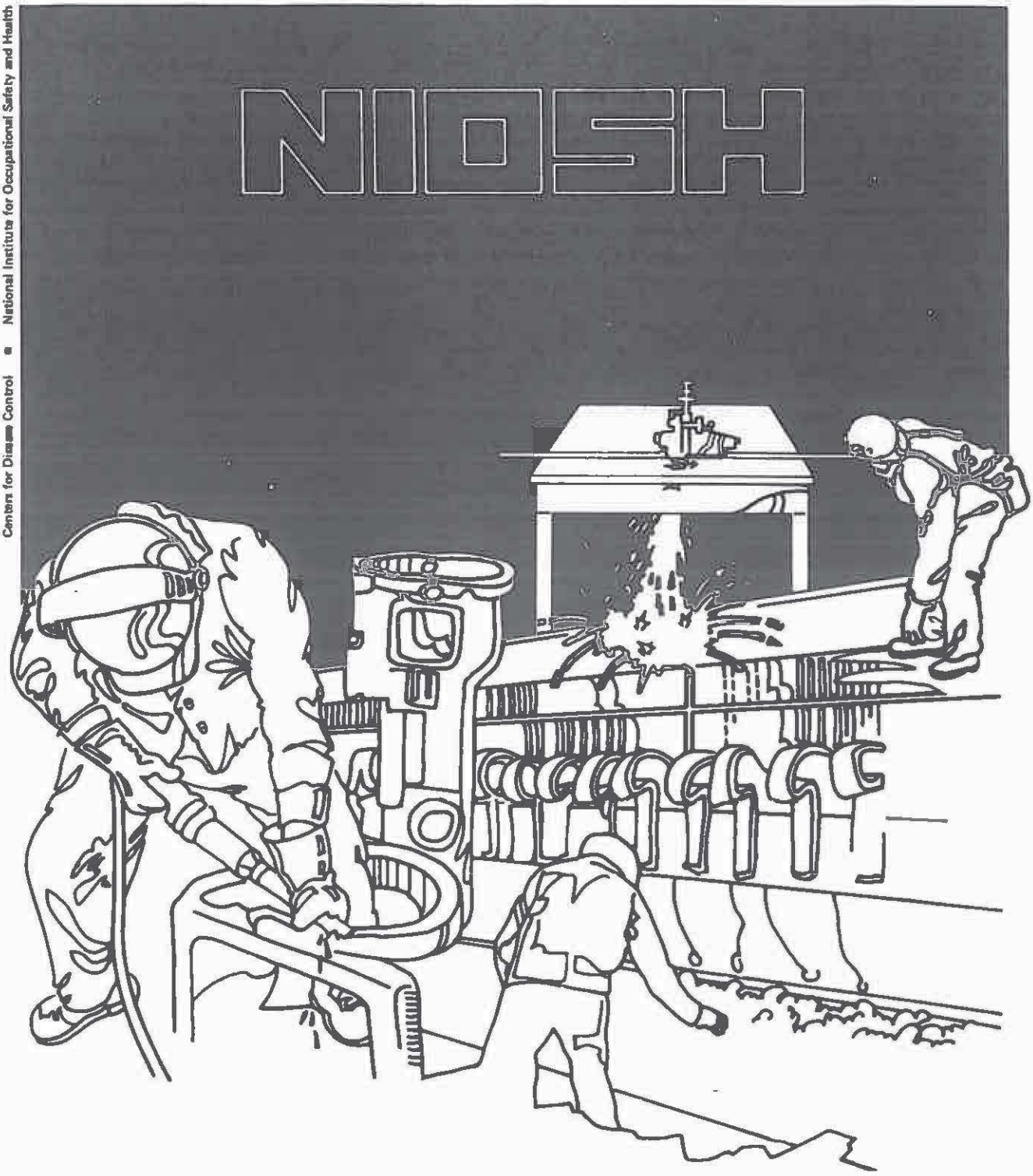
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 82-239-1355
ALLEN BRADLEY COMPANY
MILWAUKEE, WISCONSIN

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 82-239-1355
AUGUST 1983
ALLEN BRADLEY COMPANY
MILWAUKEE, WISCONSIN

NIOSH INVESTIGATOR
Peter Orris, M.D., MPH

I. SUMMARY

On April 29, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation Request from an authorized representative of the United Electrical, Radio, and Machine Workers of America, Local 1111, concerning the incidence of cancer over the past four years amongst the employees in Department 205 of the Allen-Bradley Company in Milwaukee, Wisconsin.

On May 18, 1982 NIOSH conducted an initial survey during which an opening conference was held with representatives of management and the union, a walk through of the area of concern was conducted, and pertinent medical and environmental information was requested.

A review of the process and of material safety data sheets provided by the company indicated that there were three potentially carcinogenic exposures in Department 205; asbestos - no longer in use in the department; benzene - possibly in the environment as a contaminant of toulene or xylene solvents; and formaldehyde - currently in use as a cleaning agent.

Three hundred and four employees had worked in Department 205 between 1960 and 1970, of which two hundred and fiftyseven were women. Three of the female employees (all were below fortyfive years of age) were diagnosed as having breast cancer; one employee, in her late fifties, was reported to have cancer of the uterus; and one employee had cancer of the colon. Another employee had developed cancer of the breast, yet she was not included in this review as she had not begun work in this department until 1972.

Utilizing the incidence data available from the Connecticut tumor registry, 3.2 cases of breast cancer would be expected in a group of this size with similar age characteristics based on a crude rate of 70/100,000 women or 3.0 cases based on an age adjusted rate of 65/100,000 women.

Based on the data available in this study NIOSH concludes that workers in Department 205 of the Allen-Bradley Company in Milwaukee, Wisconsin are not at increased risk of developing cancer. Current use of formaldehyde presents a potential hazard for workers in the press area of this department. Careful monitoring, as well as an active control program is advisable.

KEYWORDS: SIC 3621, (electrical industrial apparatus), formaldehyde, asbestos, epoxy, varnish, electrical coils.

II. INTRODUCTION

On April 29, 1982, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation request from an authorized representative of the United Electrical, Radio, and Machine Workers of America, Local 1111. The request expressed a concern about the incidence of cancer over the past four years amongst the employees in Department 205 of the Allen-Bradley Company in Milwaukee, Wisconsin.

On May 18, 1982 NIOSH conducted an initial survey. An opening conference was held with representatives of management and the union, followed by a walk through of the area involved. At a closing conference, the data needed for this investigation were delineated by NIOSH. All parties involved were cooperative and expressed interest in aiding the study.

On June 18, 1982 an interim report was produced which reported on the prior activities and requested information from the company concerning a cohort of workers employed in Department 205 between 1960 and 1970. This information included medical as well as demographic data. Additionally material safety data sheets were solicited on all chemicals in use in this department over the last 23 years. On March 15, 1983 all additional medical and environmental information was received by NIOSH.

III. BACKGROUND

A. Plant Production and Workforce

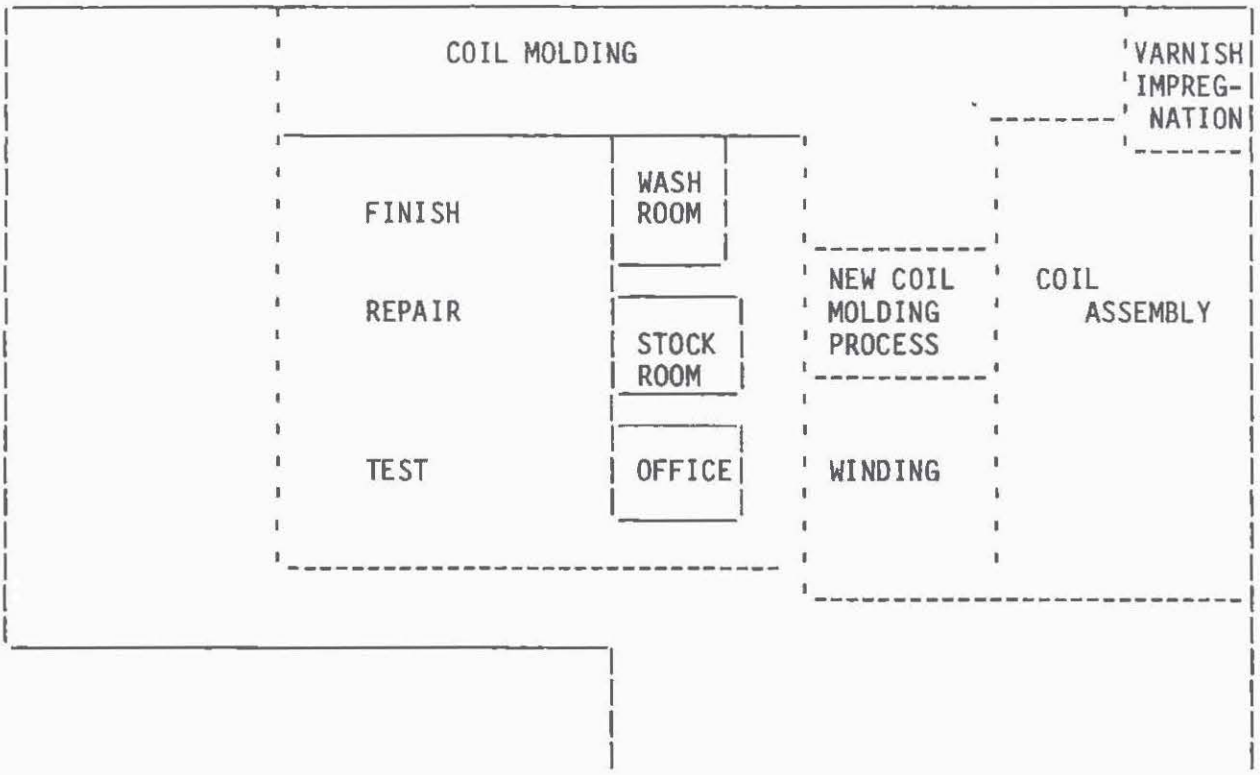
The Allen-Bradley Company, Milwaukee plant, manufactures electrical, industrial control devices. Raw materials consist of electrical components and coatings which are processed into motor starters and switches of various types. The plant was first opened in 1904 and at the time of this evaluation employed approximately 3,000 production and 1200 administrative employees. The particular area of concern in this request is Department 205 which produces wire coils. This operation has been conducted in the same area and manner since 1960, and at the time of the evaluation employed 61 production and 6 supervisory workers.

B. Description of Employee Duties

Of the workers in Department 205 at the time of the survey, 13 were Machine Operators and 2 Machine Set Up, 14 Coil Molders and 2 Coil Molder Set up, 28 Assemblers, 1 coil impregnator (varnish), and 1 machine repair worker. There were four major subdivisions of Department 205; 9 employees working in the winding area, 17 in the molding area, 12 in the assembly area, and 23 in the finishing and testing area. These employees worked an 8 hour day, 5 day week. For the past two years, two (previously three) shifts have been operating in the molding area. There were 51 production employees on the 7-3:30 shift and 9 employees working 3:30 to 11:00. The work area was approximately 5,000 square feet in size and located on the fifth floor. The ceiling was approximately 20 feet above the floor and there was a combination of window, local exhaust and general exhaust ventilation.

C. Schematic of Department 205

Allen-Bradley
5th Floor Building 39/40



D. Process Description

The employees in Department 205 assemble two basic types of coils; paper core/varnish covered and plastic core/epoxy covered.

1. Paper Core/Varnish Covered Coils:

Polyurethane covered wire is first wrapped around a 3 inch paper tube in the winding area. Following the insertion of paper sheets between the layers of wire, the ends of the wrapped tubes are cut on a band saw and moved to the assembly area. There, the ends of the wire are stripped and soldered to an external metal housing which is added to the coil. Local exhaust ventilation is utilized in this area.

The finished coil is then transported to the varnishing area where it is placed in a sealed drum by the varnishing employee and varnished under high pressure for several hours . The batch is then removed and placed in an oven for 8 to 10 hours of baking. The batches are then placed on a rack to dry. Between 1964 and 1978 the rack was lined with kraft paper containing asbestos which the impregnator coil worker would cut with scissors for each batch. The impregnation tanks, ovens, and drip racks have local exhaust ventilation. The working area in the varnish section has no local ventilation though the windows provide circulation in the summer. The completed coils are moved to the finishing area for labeling and testing, and are then placed in the stock room.

2. Nylon Core/Epoxy Covered Coils:

The nylon core coils are also wound in the winding area and soldered in the assembly area. These coils are then transported to the molding area. The 4 inch wide wire wrapped coils are placed in a press along with preheated epoxy powder in pill form. These epoxy pills are produced in the molding area by compression of powder. Under heat and pressure the epoxy pill is molded around the coil, with local ventilation in place. These presses are regularly cleaned with a formaldehyde based cleaner.

The coated coils are next brought to the finishing area, where flanges of epoxy are sanded off and defects are filled with an epoxy filler called Araldite, with local ventilation in place. The specifications of the coils are printed on the outside of the coils before testing and storage.

Some workers reported smelling varnish fumes throughout the molding area when a batch of coils was removed from the impregnators. This was especially noted in the winter. In the molding area, epoxy was also smelled when the pills were heated for molding.

IV. MATERIALS AND METHODS

A. ENVIRONMENTAL

Material safety data sheets on all chemicals in use in Department 205 were evaluated. This review identified those chemicals, especially known or suspected carcinogens, to which a significant number of the employees are potentially exposed.

B. MEDICAL

The insurance, union, and company records of all employees working in Department 205 between 1960 and 1970 were reviewed. This group was selected because the department started to function in 1960 and an adequate period between exposure and the development of disease is necessary when assessing carcinogenisis. The total person years of exposure for this group were calculated on the basis of the number of years since first exposure per person with a 10% reduction to correct for deaths before the time of the study. An expected number of deaths was then calculated utilizing the rate of cancer in the sex and race matched adult population of the United States and available through the Connecticut Cancer Registry.[1-3]

The tumor types evident on this record review were assessed as to known environmental causes, through the use of NIOSH's extensive library and computerized data bases, in an effort to identify specific environmental toxins to which these employees may have been exposed.

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 (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 primarily 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 U.S.C.651, et seq. to meet only 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.

Three potential carcinogenic exposures of the employees in Department 205 were formaldehyde, asbestos, and benzene.

1. Formaldehyde

Irritation of the eyes, nose, mouth, and throat are the most common worker health effects from inhalation of formaldehyde gas. Formaldehyde has a very pungent, offensive odor that is noticeable even in very small concentrations, producing burning and tearing of the eyes. Higher concentrations usually bring difficulty in breathing, intense burning of the eyes, nose and throat, profuse tearing, and severe coughing. Prolonged exposure to high concentrations may cause headache, heart palpitations, and serious inflammation of the bronchial tubes and lungs. In extreme cases, death may result due to swelling or spasm of the vocal cords. Asthmatic symptoms, such as wheezing, may occur, even at very low concentrations, in persons with an allergic sensitivity to formaldehyde.

Workers repeatedly exposed to low concentrations of formaldehyde during normal work periods seem to develop a physical tolerance to formaldehyde and can work in concentrations that are intolerable to many outsiders. Chronic symptoms that are associated with repeated exposure are itching eyes, dry and sore throat, disturbed sleep, and unusual thirst upon awakening.

Dermatitis may result from formaldehyde contact with the skin. Formaldehyde acts on the skin cells both as an irritant and as a tanning agent. The dermatitis usually appears first as a reddening of the skin and then small blisters may form similar to those caused by poison ivy. Formaldehyde may also make the fingernails soft and brownish. Skin irritation seldom results from exposure to formaldehyde gas in the air, but individuals who have developed an allergic sensitivity show dermatitis symptoms from exposure to concentrations easily tolerated by nonallergic persons.

Recently, formaldehyde vapor has been found to cause a rare form of nasal cancer in rats by two different research institutions. These results have prompted NIOSH to recommend that formaldehyde be handled as a potential occupational carcinogen.[4]

The OSHA standard for formaldehyde requires an 8-hour TWA concentration limit of 3 parts per million (ppm), a ceiling concentration of 5 ppm, and an acceptable maximum peak above the ceiling concentration of 10 ppm for no more than a total of 30 minutes during an 8-hour shift. NIOSH recommends that formaldehyde be handled in the workplace as a potential occupational carcinogen. Safe levels of exposure to carcinogens have not been demonstrated, but the probability of developing cancer should be reduced by decreasing exposure.[5]

2. Asbestos

Asbestos causes a variety of human diseases including asbestosis, cancer of the lungs and digestive tract, and mesothelioma. Asbestosis is a lung disorder characterized by a diffuse interstitial fibrosis, including pleural changes of fibrosis and calcification. Asbestos bodies may be found in the sputum, and the worker exhibits restrictive pulmonary function. Accompanying clinical changes may include fine rales, finger clubbing, dyspnea, dry cough, and cyanosis. These findings may be delayed in onset 10 - 15 years following cessation of exposure.

Bronchogenic carcinoma and mesothelioma of the pleura and peritoneum are also caused by asbestos exposure. Excesses of cancer of the stomach, colon, and rectum have been found among asbestos workers. These cancers may occur following a very limited exposure 20 to 30 years earlier.[6]

NIOSH recommends that occupational exposure to asbestos be controlled so that workers are not exposed to a workroom air concentration for an 8-hour TWA exposure of 0.10 fibers greater than 5 microns in length per cubic centimeter (fibers/cc) and 0.5 fibers/cc for a 15-minute ceiling concentration. The OSHA standard for asbestos for an 8-hour TWA exposure is 2 fibers/cc and a ceiling concentration of 10 fibers/cc. The ACGIH recommends a TLV of 0.10 fibers/cc.[5]

3. Benzene

Benzene vapor may cause irritation of the eyes, nose, and throat. Repeated or prolonged skin contact with benzene may cause drying and defatting of the skin which may lead to dermatitis. Liquid benzene is irritating to the eyes and mucous membranes, and aspiration of a few milliliters may cause chemical pneumonitis, pulmonary edema, and hemorrhage. Acute exposure to benzene vapor may cause central nervous system depression, and dizziness, nausea, vomiting, and abdominal pain, drowsiness, and unconsciousness. Death has occurred following a large acute exposure as a result of cardiac arythmias.

Chronic exposure of humans to benzene causes aplastic anemia and leukemia. It has been most closely associated with acute myelogenous leukemia but a few investigators have found association with chronic leukemias as well.[7]

The current OSHA standard for benzene is 10 ppm averaged over an 8-hour work shift, with a 25 ppm ceiling. NIOSH has recommended that the permissible exposure limit should be a ceiling of 1 ppm over a 60 minute period.[5]

VI. RESULTS

Three hundred and four employees worked in Department 205 between 1960 and 1970. Two hundred and fifty seven were women. The average age at time of first exposure to this department was approximately 24.4 years, and at the time of the study was 42 years. This group had an average of 17.5 years since their first exposure at the time of the study in 1982.

Three employees who had worked in Department 205 between 1960 and 1970 were diagnosed as having breast cancer. All were below forty-five years of age. One employee was reported to have cancer of the uterus and was in her late fifties. One employee had cancer of the colon diagnosed in 1982. Another employee had developed cancer of the breast. She was not included in this review as she had begun work in this department in 1972.

Three potentially carcinogenic exposures were found on review of the process and material safety data sheets.

Asbestos - This material is no longer in use in the department.

Benzene - This material may possibly be in the environment as a contaminant of the toluene or xylene solvents in use.

Formaldehyde - This material is currently in use as a cleaning agent in the presses.

VII. DISCUSSION

Breast Cancer:

The 257 women in this group had an average of approximately 18 years at risk for the development of breast cancer, giving a total of 4626 female person years at risk for this cohort. Assuming that all the women had two breasts at risk for cancer; none began work in this department with preexistent breast cancer; and each was approximately the same age at entry into this department, and utilizing the incidence data available from the Connecticut tumor registry,[7] 3.2 cases of breast cancer would be expected in a group of this size, with similar age characteristics, based on a crude rate of 70/100,000 women or 3.0 cases based on an age adjusted rate of 65/100,000 women.[1]

Therefore, the occurrence of breast cancer in this group is not elevated over the rate expected for the general population. Additionally, following an exhaustive search of the world medical literature, there would appear to be no known environmental cause of breast cancer. No environmental factor associated with the work place would seem to be implicated in the development of breast cancer in these individuals.

Cancer of the Colon and Endometrium:

The occurrence of single cancers as common as those of the colon and endometrium are well within that which would be expected in this group without the occurrence of a specific occupational exposure.

VIII. CONCLUSIONS

1. No increased risk of cancer was found to occur in workers who worked in Department 205 between 1960 and 1970.

2. Current use of formaldehyde presents a potential hazard for workers in the press area.

IX. RECOMMENDATIONS

1. Formaldehyde should be handled as a potential human carcinogen and therefore careful monitoring and an active program to keep exposure at or below the limit of detection of the monitoring equipment is advisable.

X. REFERENCES

1. Cancer in Connecticut: Incidence Characteristics 1935-1962, Conn. State Dept of Health, 1967,

2 Rinsky, R.A. et. al, Epidemiologic Study of Civilian Employees At The Portsmith Naval Shipyard, Kittery, Maine, U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute For Occupational Safety and Health, Div. of Surveillance, Hazard Evaluations, and Field Studies, Cincinnati, Ohio, Dec. 1980, (unpublished).

3. Beumont, James, and Breslow, Norman Power Considerations in Epidemiologic Studies of Vinyl Chloride Workers, American Journal of Epidemiology, 114 (5), P. 725-34, Dec. 1981.

4. NIOSH Current Intelligence Bulletin No. 34, DHHS (NIOSH) Pub. No. 81-111, Dec. 23, 1980.

5. Occupational Health Guidelines for Chemical Hazards, NIOSH/OSHA, U.S. Dept. of Labor, DHHS(NIOSH) Publication 81-123, 1981,

6. Proctor, N.H. and Hughes, J.P., Chemical Hazards of the Workplace J.P. Lippincott Company, Philadelphia, 1978, pp. 112-113.

7. Occupational Diseases, A Guide to Their Recognition Revised Edition, DHEW (NIOSH) Publication No. 77-181, June 1977.

XI. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

Peter Orris, MD, MPH
Medical Officer
NIOSH - Region V
Chicago, Illinois

Epidemiologic Support:

Robert Rinsky
Division of Surveillance,
Hazard Evaluations &
Field Studies
Hazard Evaluation and
Technical Assistance
Branch
Cincinnati, Ohio

Originating Office:

Division of Surveillance,
Hazard Evaluations &
Field Studies
Hazard Evaluation and
Technical Assistance
Branch
Cincinnati, Ohio

XII. DISTRIBUTION AND AVAILABILITY OF THE REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services (NTIS), Springfield, Virginia. 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 the following:

A. Allen Bradley, Inc.
B. United Electrical, Machine, and Aerospace Workers
C. U.S. Department of Labor, OSHA - Region V
D. NIOSH Regional Offices/Divisions

For the purposes of informing the affected employees, copies of the report should be posted in a prominent place accessible to the employees, for a period of 30 calendar days.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

Third Class Mail

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396