U.S. Department of Health, Education, and Welfare
Center for Disease Control
National Institute for Occupational Safety and Health
Cincinnati, Ohio 45226

Health Hazard Evaluation Determination
Report No. 77-23-401

General Electric Company
Appliance Park
Louisville, Kentucky

June 1977

I. TOXICITY DETERMINATION

A health hazard investigation was conducted in the Enamel Shop of the Range Department at the General Electric Company, Louisville, Kentucky, on February 24 and 25, 1977, by a NIOSH industrial hygienist. The investigation dealt with airborne dust in the Panel Spray Booth and the adjacent mezzanine where oven liners and door liners are inspected. The ventilation systems were visually inspected, and all day-shift employees of these areas were privately interviewed. Personal air samples were collected from the breathing zones of exposed employees on February 25 to measure the levels of exposure to silica and total airborne dust.

The airborne exposures to silica and nuisance dust are not believed to be toxic to employees at the levels measured during the NIOSH site visit. The measured levels were found to be within acceptable limits of exposure which have been established to prevent harmful effects on the health of employees.

Interviews with exposed employees revealed that many of them have experienced symptoms of eye and nose irritation from exposure to the dust. Although the dust exposure is not believed to pose any danger to the employees' health, this irritation can and should be minimized. Recommendations are offered in Section IV. E of this report for the prevention of dust irritation and for compliance with good industrial hygiene practice.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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

Copies of this report have been sent to:

A. Employee Requester
B. General Electric Company, Louisville, Kentucky

C. International Union of Electrical, Radio, and Machine Workers Local 761, Louisville, Kentucky
D. Kentucky Department of Labor, Frankfort, Kentucky
E. U.S. Department of Labor, OSHA - Region IV, Atlanta
F. NIOSH Regional Consultant - Region IV, Atlanta

For the purposes of informing the approximately 13 "affected employees", the employer will promptly "post" the Determination Report for a period of 30 calendar days in a prominent place(s) near where affected employees work.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from a group of employees regarding their exposure to recirculated dust arising from the application of a white enamel coating on kitchen range panels at the General Electric Company, Appliance Park, Louisville, Kentucky.

IV. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

The areas under study are located in Building 2, Range Department, Enamel Shop. The mezzanine where some of the exposed employees work is situated above and to one side of the Panel Spray Booth. The two work groups located on the mezzanine are the door liner inspection (Section 220) and the oven liner inspection (Section 221). There are approximately 4 employees in each section on the day shift, and only 2 or 3 employees in the entire area on the evening shift.

In the Panel Spray Booth, a mixture of raw ingredients (which will become enamel after baking and fusing) is sprayed onto range panels. The overspray is intended to be trapped in a waterfall, but that which is not trapped is vented onto the roof of the building without further filtration. Figure 1 depicts the arrangement of the operation. There are two sprayers and one utility man on the day shift only.

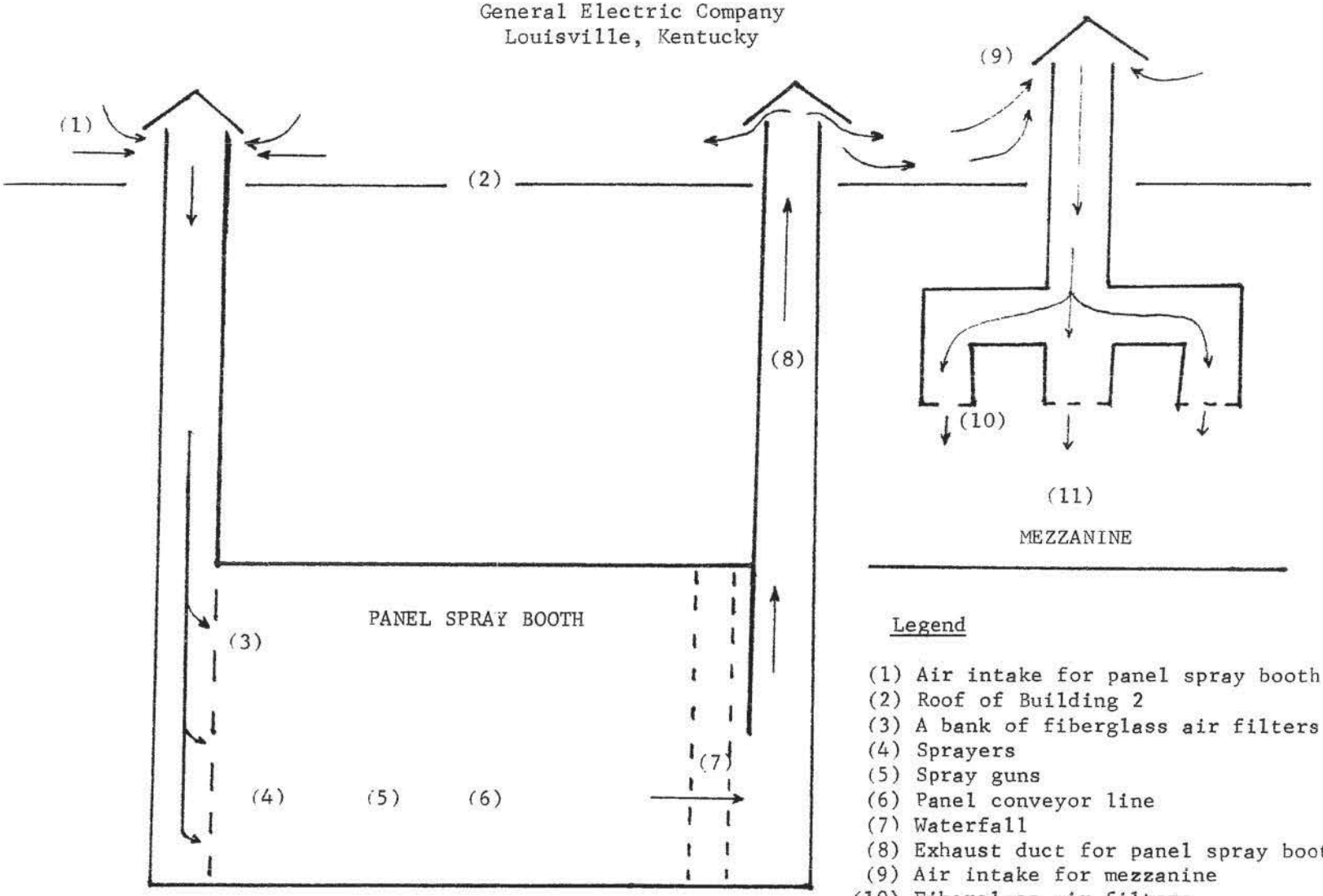
The basic problem is that the air intake for the mezzanine is located on the roof within six to ten feet of the overspray exhaust. Some of the overspray dust is captured by the air intake and is vented upon the employees on the mezzanine.

After NIOSH notified the company management of the employee request for a health hazard evaluation, and prior to the NIOSH site visit, a number of changes were made:

FIGUR

SCHEMATIC DIAGRAM OF ENAMEL SHOP VENTILATION SYSTEM

General Electric Company
Louisville, Kentucky



Legend

(1) Air intake for panel spray booth
(2) Roof of Building 2
(3) A bank of fiberglass air filters
(4) Sprayers
(5) Spray guns
(6) Panel conveyor line
(7) Waterfall
(8) Exhaust duct for panel spray booth
(9) Air intake for mezzanine
(10) Fiberglass air filters
(11) Employee work stations on the mezzanine

1. The Panel Spray Booth was tested for overspray escape, and the waterfall dust control device was repaired and serviced.

2. The exhaust duct from the Panel Spray Booth and the air intake duct for the mezzanine had been at approximately the same height on the roof. The height of the intake duct was increased by approximately four feet.

3. Fiberglass air filters were installed at the fresh air duct outlets on the mezzanine.

4. The area employees were consulted about the problem.

5. Some of the accumulated dust was removed from sections of horizontal ducts which provide fresh air for employees on the mezzanine.

B. Evaluation Design and Methods

The composition of the enamel mixture includes frit, silica flour, pigments, inorganic metal oxides and salts, clay, and vegetable gums. It is a conventional mixture very similar to that described in readily available technical literature.[1] Frit which makes up over 90% of the mixture is reportedly a fused form of siliceous material. It is probably chemically and toxicologically similar to glass. Free crystalline silica makes up 2% of the mixture. Since most of the components of the mixture fall into the category of inert or nuisance dusts, it was judged that silica was the only toxic component that might be present in sufficient quantities to require a specific evaluation. The enamel mixture is sprayed using water as the carrier.

Total airborne dust was measured as an index of potential irritation to the eyes, skin, and upper respiratory tract. Air was drawn through a pre-weighed Gelman VM-1 filter at a known and constant rate. After sampling the filter was again weighed to measure the weight gain due to collected particulate matter. The weight of collected particulate matter and the volume of air drawn through the filter were used to calculate the average particulate concentration in the air during the sampling period.

Respirable dust was sampled and analyzed for free, crystalline silica as an index of the potential for long-term respiratory damage. Respirable dust was measured by drawing air at a rate of 1.7 liters per minute first through a 10-mm nylon cyclone to remove the larger, non-respirable particles prior to the collection of the respirable particles on a pre-weighed MSA FWS-B filter. The amount of the collected respirable dust was determined by an x-ray diffraction method[2] after the filters were reweighed and then dissolved in tetrahydrofuran.

All day-shift employees of the Panel Spray Booth and the adjacent mezzanine were privately interviewed to determine if the employees were experiencing any health problems which they felt might be job related.

C. Evaluation Criteria

The following criteria were used for evaluating the potential hazard of the air contaminants:

1. Total and respirable mineral dust containing silica.

The present U.S. Occupational Health Standards promulgated by the U.S. Department of Labor, Occupational Safety and Health Administration, were used.[3] These are the present legal standards:

Respirable: $10 \text{ mg/m}^3 \div (\% \text{ SiO}_2 + 2)$

Total dust $30 \text{ mg/m}^3 \div (\% \text{ SiO}_2 + 2)$

The quantity of free silica in the respirable dust samples was too small to be detected by analysis. A bulk sample of the overspray was collected from the Panel Spray Booth. This sample was analyzed by the Talvitie method[4] and found to contain 2.4% free silica.

The assumption was made that the airborne dust would also consist of 2.4% free silica. If this assumption is valid, the standards for this operation would be:

Respirable: 2.3 mg/m^3

Total dust: 6.8 mg/m^3

(mg/m^3 = milligrams of dust per cubic meter of air)

2. Free, crystalline silica.

NIOSH, in its criteria document for crystalline silica[5], has recommended that a new occupational health standard be established to limit exposure to 50 micrograms /m^3 of respirable free silica. This limit has been recommended to prevent the development of silicosis, a progressive and frequently incapacitating disease of the lungs in which the lungs "harden" and lose much of their elasticity due to the development of fibruous tissue in the lungs caused by inhaling silica dust.

Both the present U.S. Occupational Health Standards and the NIOSH recommended standard are employee exposure levels which refer to average daily and weekly exposures. It is believed that these standards represent average air contaminant levels for a 8- to 10-hour workday or 40-hour workweek to which nearly all workers may be repeatedly exposed, day after day, without any significant adverse effect on their health.

D. Evaluation Results and Discussion

1. Air Sampling

Air samples were collected from sprayers in the Panel Spray Booth and from inspectors and transfer operators on the nearby mezzanine

during the spraying of the mixture for white enamel. On the day of sampling, February 25, the white spray operation lasted for only 4 hours.

a. Panel Spray Booth

Although the two sprayers were wearing dust filter masks, personal breathing zone samples were collected. The average total dust levels for the 4-hour sampling period were 1.2 and 2.3 mg/m^3 for the two men. Respirable dust levels were 0.3 and 0.2 mg/m^3 (300 and 200 $micrograms/m^3$). The quantity of free silica was below the limit of detection on both respirable samples. The limit of detection (smallest amount measurable) for free silica by x-ray diffraction was 40 micrograms per filter, according to the analytical report of the Utah Biomedical Test Laboratory. A bulk sample of the overspray contained only 2.4% free silica.

By comparison with the standards used as evaluation criteria, it appears that these levels of dust were not toxic. Furthermore, the employees were protected from dust inhalation by dust filter masks which they were wearing. Other observations deserve mention here.

(1) The ventilation for the booth was excellent. A large volume of fresh, make-up air was provided to the booth and passed through fiberglass filters. The air moved at a high rate past the sprayer, then the spray nozzle, the panels being sprayed, and through a waterfall to a duct leading to discharge on the roof.

(2) Much of the spraying was automated. Only the edges of the panel required manually operated spraying.

(3) The spray was a suspension of solids in water. Therefore, the solids were wetted and very little airborne dust was generated.

The exposures of the employees in the Panel Spray Booth were excellently controlled.

b. Mezzanine

The dust reaching the mezzanine was overspray from the Panel Spray Booth which was brought back into the building through fresh air intakes on the roof. Fiberglass filters had been installed at the fresh air outlets on the mezzanine several weeks prior to the NIOSH site visit.

Two employees were selected to wear air samplers for measuring total dust exposure, and two other employees for respirable dust. One area sample was collected for total dust. The measured total dust levels were 0.2, 0.3 (the area sample), and

0.3 mg/m^3. Respirable dust levels were too low to be measured; the weight gain of sample filters was no greater than that of unused filters. The amount of respirable silica on the filters was also non-detectable; the lower limit of detection was 40 micrograms of silica per filter. These measurements indicate that exposures to airborne dust were not toxic.

2. Employee Interviews

a. Panel Spray Booth

Of the three employees in the booth, none reported any health problem related to dust exposure. Only one employee mentioned a job-related problem - that the cold fresh air used for ventilating the booth aggravates arthritis in his back.

b. Mezzanine

The exposure of employees to dust which is recirculated from the exhaust of overspray from the Panel Spray Booth has produced widespread irritation of the eyes and nose in the past. Table 1 summarizes the symptoms of irritation as reported by the employees and shows that the irritation has been greatly reduced by the installation of air filtration for the fresh air supply.

Other information, as reported by employees, is:

(1) The waterfall system for the Panel Spray Booth has not always been properly maintained. One day in particular there was a malfunction, perhaps a breakdown of the waterfall pump, and it became extremely dusty on the mezzanine.

(2) While one employee stated that the dust level on the day of the NIOSH sampling was lower than it had been in the past several weeks, two other employees estimated that the day of the NIOSH visit was quite typical of days since the air filtration was installed.

(3) Five of the eight employees of the area mentioned that the filters have reduced the dust level considerably. However, some dust is still getting out of the ducts despite the filters, and there is a considerable quantity of accumulated dust in the air supply ducts.

E. Recommendations

Although the dust exposure of employees on the mezzanine is not believed to pose any danger to the employees' health since the installation of filters for their fresh air supply, the irritation caused by the dust should be minimized. The exhaust of air contaminants on the roof and the intake of

TABLE 1

NUMBER OF EMPLOYEES EXPERIENCING IRRITANCY SYMPTOMS
ON THE MEZZANINE

General Electric Company
Appliance Park
Louisville, Kentucky

Bldg. 2, Range Dept., Enamel Shop
Sections 220 and 221

February 25, 1977

Symptom	Before Filter Installation	Since Filter Installation	Day of Survey
Stopped up nose	4	2	2
Sore nose	1	1	1
Red eyes	2	1	1
Burning eyes	2	1	0
"Irritated" eyes	2	0	0
Skin itch	1	1	0

Total number of employees = 8

fresh air in the same vicinity of the roof without contaminant removal is obviously inconsistent with good industrial hygiene practice. The following recommendations are offered for consideration:

1. An effective air cleaning system should be maintained to prevent recirculation of excessive amounts of exhausted air contaminants.

2. The waterfall overspray capture device in the Panel Spray Booth should have a regular and frequent schedule of inspection and maintenance.

3. If filters are used to clean the air provided through ventilation to the mezzanine, the filters should have a regular and frequent schedule of inspection and replacement.

4. All sections of horizontal ductwork should be cleaned out at regular intervals and when needed to remove accumulations of settled dust to prevent the dust from becoming airborne once more and from restricting air flow through the duct.

5. A person of authority should establish a system to insure that periodic inspection and maintenance of control systems are performed and reported to him.

6. Good industrial hygiene practice declares that discharge stacks extend 1.3 to 2.0 times the height of the building and air discharged and intake ducts be widely separated. (ACGIH Vent Manual p. 6-4 - 14th Ed.)

7. The large rain caps on the discharge ducts should be removed and the ducts extended to the proper height.

8. All air intake ducts should be brought close to roof level.

NOTE: No violations were found of legal OSHA standards for air contaminants. These recommendations are optional and are offered as ways to minimize irritation from dust exposure.

V. REFERENCES

1. Encyclopaedia of Occupational Health and Safety, Vol. I, 456-458, International Labour Office, Geneva, Switzerland, 1971.

2. NIOSH Manual of Analytical Methods, Method No. P&CAM 109, NIOSH, Cincinnati, Ohio, 1974.

3. General Industry Standards, OSHA Publication No. 2206, Table Z - 3, p. 510, U.S. Department of Labor, Occupational Safety and Health Administration, Washington, D.C., January 1976.

4. Analytical Chemistry, Vol. 23, No. 4, April 1951

5. Criteria for a recommended standard.... Occupational Exposure to Crystalline Silica, HEW Publication No. (NIOSH 75-120), 1974.

VI. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

C. Paul Roper, Jr.
Regional Industrial Hygienist
Division of Prevention
Public Health Service, Region IV
50 Seventh Street, N.E.
Atlanta, Georgia 30323

Originating Office:

Jerome P. Flesch
Acting Chief
Hazard Evaluation and Technical Assistance Branch
NIOSH
Cincinnati, Ohio 45226

Laboratory Analysis:

Utah Biomedical Test Laboratory
520 Wakara Way
Salt Lake City, Utah 84108
(a NIOSH contractor)