U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES • Public Health Service
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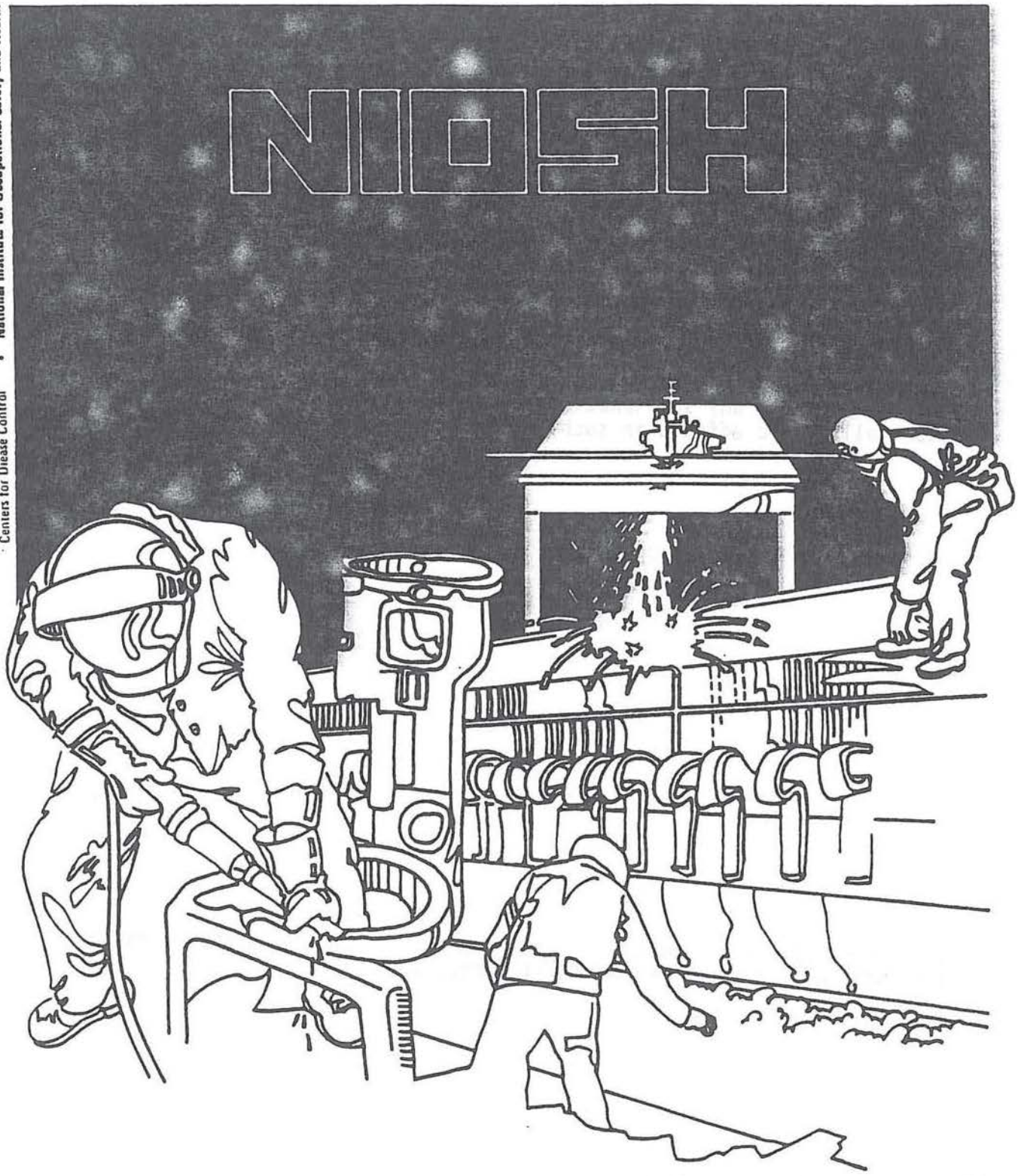
NIOSH



Health Hazard Evaluation Report

80-28-766

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. 699(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.

HE 80-28-766
NOVEMBER 1980
DETROIT EDISON COMPANY
MONROE POWER PLANT
MONROE, MICHIGAN

NIOSH INVESTIGATORS:
Steven Ahrenholz, I.H.
James Taylor, M.D.

I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a request from Local 223 of the Utility Workers Union of America (UWUA) to evaluate dermatological problems reportedly being experienced by General Maintenance Journeymen exposed to fly ash and coal dust at the Detroit Edison Company - Monroe Power Plant, Monroe, Michigan.

An environmental evaluation was conducted at the plant on January 29-31, 1980. Personal breathing zone respirable dust samples were obtained for coal dust and fly ash. The mean respirable coal dust concentration measured on 35 samples was 2.2 mg/M^3 (range 0.11 - 23 mg/M^3). Twenty-three percent of the respirable coal dust samples exceeded the American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Value (TLV) for respirable coal dust containing less than 5% quartz of 2 mg/M^3. Seventeen personal samples collected for fly ash had a mean concentration of 0.78 mg/M^3 (range 0.14 - 4.43 mg/M^3). All measured fly ash levels were below the TLV for respirable dust of 5 mg/M^3.

A medical investigation to examine dermatologic problems was conducted May 20-22, 1980. A dermatologic interview and examination were conducted with 31 employees reporting skin problems. Of the 31 workers interviewed, 10 (32%) gave a history of skin disorders which they attributed to fly ash. However, there was no specific common factor in their history such as seasonal variation, location, and morphology. On examination 10 (32%) had no significant cutaneous eruption. The other 21 had a variety of skin disorders, with five disorders occurring in more than one individual. All of these were relatively common and the occurrence of 2 or 3 cases of each among a population of 500 people would not be surprising.

NIOSH has determined on the basis of environmental results, that workers at Detroit Edison are exposed to levels of coal dust in excess of the recommended level. The dermatologic evaluation did not provide any evidence of a pattern of dermatologic problems attributable to fly ash or coal dust. It is possible, however, that in individual cases, a skin problem may have been caused or exacerbated by the occupational exposures. Recommendations concerning dust control, education and personal protective equipment are presented on pages 6 and 7.

KEYWORDS: SIC 4911 (Electric Services), coal dust, fly ash, dermatitis.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request on November 14, 1979 from the President of Local 223, Utility Workers Union of America, to conduct a health hazard evaluation (HHE) at the Detroit Edison Company's - Monroe Power Plant located in Monroe, Michigan. The purpose of the health hazard evaluation was to investigate employee exposures to fly ash and coal dust and its role concerning skin problems being reported by the employees. The concern focused on maintenance employees representing all trades and working throughout the plant. Environmental sampling was conducted January 29-31, 1980. A medical follow-up investigation to examine dermatologic problems experienced by the workers was conducted May 20-22, 1980. Interim reports summarizing initial survey findings and environmental sampling results preceded the medical follow-up.

III. BACKGROUND

A. Plant History:

The Monroe Power Plant began operating in 1971, the final unit going on line in 1974. There are four 750,000 kilowatt generating units, each operating independently of the others. These units are housed in a single 13-story, 2.1 million square foot building. Coal unloading, storage, and fuel supply facilities are located on the surrounding 1200 acre site. Coal consumption per unit ranges up to 300 tons per hour. During the survey about 500 employees were working at the Monroe Plant.

The plant operates on a three shift rotating schedule. Maintenance personnel shifts are 7:30 - 4:00 p.m.; 3:30 p.m. - 12:00 a.m.; and 11:30 p.m. - 8:00 a.m.

B. Maintenance Personnel Job Description:

The majority of maintenance workers are General Maintenance Journeymen (G.M.J's) representing the electrical, mechanical (millright, pipefitting, welding, and structural steel trades. Each G.M.J. is required to function as a first-class journeyman in at least one of the five trades with ability to function in a second-class capacity in at least one of the other four trades. Ability to perform as a third-class helper in all remaining trades is required. Workers perform most of the repair work at the equipment location. Individuals engage in troubleshooting, repairing, rebuilding, installing, modifying, inspecting, and testing a variety of power plant equipment.

C. Powerplant Operator Job Description:

Powerplant operators and assistant power plant operators monitor electrical generation activities from the two main control rooms. The

operators must make routine patrols of their assigned unit area (usually floors one and two or two through 13) and may be assigned to certain tasks out in the plant. Their responsibility is to insure that all systems are functioning properly and to investigate any problems indicated by the monitors in the control room.

D. Process Description:

Coal is transferred from the active coal pile to a conveyor which transports coal to the crusher house. Here it is crushed and transferred to the large conveyor which carries the coal into the plant. Coal enters the plant on the ninth floor, the cascade room, where it travels over a series of belts filling each successive silo with coal. There are 28 silos (7 per boiler). Coal is transferred through a closed system from the silos to the pulverizing mills where it is ground to a consistency of talcum powder. The finely ground coal is blown by a continuous blast of air into the boiler where combustion takes place. Boiler water is converted to steam during this process and used to power the high, intermediate, and low pressure turbines. Heavier ash (bottom ash) settles in a hopper at the bottom of the boiler. Combustion gases pass through the electrostatic precipitators prior to entering the stack. Fly ash collected from the bottom of the boilers and the electrostatic percipitators is mixed with water in a pipeline system and transported as a slurry to the slurry house. This slurry is pumped out to a land fill area for disposal.

The plant was blending low- and high-sulfer coal at the time of the survey and modifications were being made to the equipment to accommodate conversion to low sulfur coal.

IV. METHODS AND MATERIALS

A. Environmental:

Air sampling was conducted by using personal sampling pumps equipped with 10 mm diameter nylon cyclones to determine airborne concentrations of respirable coal dust and respirable dust (fly ash). Samples were collected on preweighed FWSB filters according to NIOSH Sampling Data Sheets 40.01 (respirable coal dust), and 29.02 (respirable dust), at rates of 2.0 and 1.7 liters per minute, respectively. Sample collectors were worn on the employees' work clothes collars. Sample results obtained for employees not wearing respirators are considered breathing zone exposures. Samples for employees wearing the disposable dust respirators are potential exposures, but labeled personal samples. Total particulate weight gain on each filter was determined gravimetrically. Quartz and cristobalite fractions were determined by NIOSH method P&CAM 259 for each filter. All sampling was conducted during the dayshift when the maximum work force was present. Sampling durations approximated the full eight-hour work shift.

Rounds were made of the areas where most employees being sampled were working to observe working conditions and the extent of direct contact with the dust. Tracking of employees was difficult due to plant size and the varied tasks each performed, so employees were asked at the end of each shift to verify that they had worked in the areas to which they were originally assigned.

Bulk samples of coal dust and fly ash were analyzed for quartz and cristobalite (using NIOSH method P&CAM 259); pH (using deionized water and reading it with a pH meter); and the metals sodium (Na), potassium (K), lead (Pb), cadmium (Cd), magnesium (Mg), and arsenic (As) using NIOSH method P&CAM 173.

B. Medical:

A medical survey was conducted on May 20-22, 1980. A dermatologist interviewed and examined 31 workers who reported experiencing skin problems.

V. EVALUATION CRITERIA

A. Environmental:

The ACGIH TLV for respirable coal dust containing less than 5% quartz is 2 mg/M^3. The OSHA standard for respirable coal dust having less than 5% silica is 2.4 mg/M^3. The respirable nuisance dust criteria (TLV and OSHA) of 5 mg/M^3 is used for fly ash.

The values for each contaminant are designed to permit an occupational exposure over an 8 to 10-hour workday, 40-hour work week, throughout an individual's normal worklife without adverse effect. Because of wide variations in individual susceptibility, a small percentage of workers may experience discomfort from some substances at or below the applicable criteria. Contributions to the overall exposure by the cutaneous route are not included in the criteria, zero cutaneous contribution being assumed.

No references to dermatologic disorders caused by coal dust or fly ash exposures were found in the occupational literature. The major concern of coal dust exposures focuses on the associated pneumoconiosis.

B. Medical:

Impressions obtained from the dermatologic evaluations represent a clinical judgement made without benefit of ancillary diagnostic measures such as potassium hydroxide scrapings for superficial fungal infections, patch testing, and observing responses to therapy. Impressions were based on the information presented during the interviews and examinations conducted by the dermatologist.

VI. RESULTS AND DISCUSSION

A. Environmental:

Figure I and Tables I and II present the results of the respirable coal dust samples. The mean respirable coal dust concentration was 2.2 mg/M^3 (S.D. $\pm$4.2, range 0.11 - 23 mg/M^3) for 35 samples. (The two highest values 240 mg/M^3 and 32 mg/M^3 were not included in the above calculations because loose material was present in the cassettes from which these samples were taken.) Quartz fractions on the filters were all below 5% of the total particulate weight. No cristobalite fraction was detected. The ACGIH TLV for respirable coal dust containing less than 5% quartz of 2 mg/M^3 is applicable. Twenty-three percent of the respirable coal dust samples exceeded this.

Coal dust exposures were below the evaluation criterion of 2 mg/M^3 for all areas except the ninth floor cascade room. Seventy-three percent of the coal dust (8 of 11) samples from the cascade room exceeded 2 mg/M^3 on January 30, 1980. On that day there was extensive maintenance and housekeeping activity in the cascade room resulting from a broken conveyor belt. All Detroit Edison employees wore NIOSH approved disposable dust respirators in the cascade room. On the second day of sampling, the activity level in the cascade room was less and so were the coal dust levels, 71% (5 or 7) falling between 1 and 2 mg/M^3. Analysis of two bulk coal dust samples obtained from the cascade room indicated an alkaline pH of 9.27 for one sample and a pH of 7.88 for the other. This difference may be due to the fact that the company blends low and high sulfur coals and reflects the differing chemical composition of the two coals.

Figure II and Table III present the results of the respirable dust sampling, assumed to represent fly ash exposures. These samples were taken largely on employees working throughout the plant, excluding the cascade room. Two fly ash exposures denoted by footnote b in Table III are more appropriately considered coal dust exposures considering the location of the workers and the detection of quartz, which was found only in the coal dust samples. There were 17 samples for respirable dust with a mean of 0.78 mg/M^3 (S.D. $\pm$1.12, range 0.14 - 4.43 mg/M^3). Quartz fractions were not measurable except for the two samples mentioned, and no cristobalite fraction was detected. The ACGIH TLV for respirable dust of 5 mg/M^3 is applicable to all but the two mentioned values. All respirable dust values obtained were below the TLV.

The results of the four bulk sample analyses are presented in Table IV. The average quartz concentration in the bulks was 1.7% by weight (S.D. $\pm$.4) and no cristobalite was detected. Sodium averaged 0.10% (S.D. $\pm$.04) by weight: potassium 0.10% (S.D. $\pm$.06) by weight; lead .004% (S.D. $\pm$.008) by weight; and magnesium 0.18% (S.D. $\pm$.14) by weight. No cadmium or arsenic was detected. The pH of aqueous solutions of the bulks averaged 9.52 (S.D. $\pm$1.49).

Identification of several metals in the bulk samples was done to determine the presence of arsenic-containing compounds, which are irritants of the skin. The presence of sodium, potassium, and magnesium compounds help explain the alkaline nature of the dusts. Lead and cadmium analyses were also conducted. No specific metal compounds were identified, and the percent contribution of these metals to the makeup of the bulk were all below 0.4 percent, with lead, cadmium, and arsenic at or below the anlytical methods limit of detection.

B. Medical:

Of the 31 workers interviewed by the dermatologist, 10 (32%) gave a history of skin disorders which they attributed to fly ash. However, there was no specific common pattern in their history such as seasonal variation, location or morphology (type of lesion).

On examination of the 31 workers, 10 (32%) had no significant cutaneous eruption. The other 21 (68%) had a variety of skin disorders. Five disorders occurred in more than one individual:

hyperpigmented areas - 2
acne of the face - 3
acneiform dermatitis (shoulders, back and/or chest) - 3
tinea pedis (athlete's foot) - 3
eczema of the hands - 3

All of these are relatively common findings and the occurrence of 2 or 3 cases of each among a population of 500 people would not be surprising.

In general, the dermatologic examinations did not provide any evidence of a pattern of dermatologic problems attributable to fly ash or coal dust, although it is possible that in individual cases, a skin problem may have been caused or exacerbated by the occupational exposures.

VIII. RECOMMENDATIONS

1. Continue use of coveralls and gloves. Clean work apparel should be worn each day.

2. Provide a lubricating lotion for workers' in the locker and shower room.

3. Enclosure of the conveyor belt system in the cascade room should be completed to reduce dust levels and the necessity for respirators except during non routine maintenance activities.

4. Incorporate routine maintenance checks of duct joints, silo and pulverizer connections, and general duct work for points of fugitive emissions.

5. Periodic review of protective equipment available throughout the plant, its use, and to provide or arrange to provide all workers in an area with the proper equipment.

6. Education programs for employees concerning substances encountered in their workplace, the health effects, and the proper precautions to be taken should be established. The union can be of assistance in identifying topics of concern.

7. More extensive use of the company's industrial hygiene services is recommended. Regular visits by the hygienist would provide an opportunity to identify and investigate problems as they occur. The size of the facility supports this recommendation.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

Evaluation Conducted and Report Prepared By:

Steven Ahrenholz, M.S.
Project Officer
Industrial Hygiene Section
Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies

Field Evaluation:

Jan Handke
Epidemiologist
Medical Section
Hazard Evaluations and Technical Assistance Branch

James S. Taylor, M.D.
Director
Industrial Dermatology Section
The Cleveland Clinic Foundation
Cleveland, Ohio

John Kominsky
Industrial Hygienist
Hazard Evaluations and Technical Assistance Branch

Jim Boiano
Industrial Hygienist
Hazard Evaluations and Technical Assistance Branch

Gary Verst
Co-Op
Hazard Evaluations and Technical Assistance Branch

Support Services:	Dorothy E. Nurre Health Technician Support Services Branch
Laboratory Analyses:	Utah Biomedical Testing Laboratory Salt Lake City, Utah
Report Typed By:	Leesa Berling Clerk-Typist

X. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available, upon request, from NIOSH, Division of Technical Services, Information Resources and Division of Technical Services, 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 22161.

Copies of this report have been sent to:

1. Detroit Edison Company - Monroe Power Plant
2. Local 223, Utility Workers Union of America AFL-CIO
3. National Utility Workers Union of America AFL-CIO
4. Michigan Department of Labor
5. Michigan Department of Public Health
6. U.S. Department of Labor, Region V
7. NIOSH, Region V

For the purpose of informing the 200 "affected employees", the employer shall promptly "post" the determination report for a period of 30 days in a prominent place near where exposed employees work.

XI. REFERENCES

NIOSH Manual of Sampling Data Sheets, U.S. Dept. of Health, Education, and Welfare. National Institute for Occupational Safety and Health, DHEW (NIOSH) Pub. No. 77-159, 1977.

Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Enviroment with Intended Changes for 1980, American Conference of Governmental Industrial Hygienists, P.O. Box 1937, Cincinnati, Ohio 45201, 1980.

Documentation of the Threshold Limit Values for Substances in Workroom Air. 3rd ed., American Conference of Governmental Industrial Hygienists, P.O. Box 1937, Cincinnati, Ohio 45201, pgs. 57, 190, 1977.

Proctor, N.S., J.P. Hughs. Chemical Hazards of the Workplace. J.B. Lippincott Co., Philadelphia, 1978.

OSHA General Industry Safety and Health Standards (29 CFR 1910). U.S. Dept. of Labor, Occupational Safety and Health Administration, OSHA 2206, Revised November 7, 1978.

TABLE I

RESPIRABLE COAL DUST CONCENTRATIONS
DETROIT EDISON COMPANY - MONROE POWER PLANT
MONROE, MICHIGAN

January 30, 1980

AMPLE DESCRIPTION				AIRBORNE CONCENTRATION OF RESPIRABLE COAL DUST-mg/M^3
eneral Work Location	Job Classification	Type[a]	Duration (Minutes)	
loor 1, unit 1	Asst. Power Plant Operator	BZ	427	0.46
loor 1, unit 2	Asst. Power Plant Operator	BZ	432	0.31
ulverizers, units 1 & 2	Maintenance	BZ	433	0.39
ulverizers, units 1 & 2	Maintenance	BZ	424	0.80
loor 6, air heaters	Maintenance	BZ	448	0.64
loor 9, cascade room	Asst. Power Plant Operator	PS	432	0.39
loor 9, cascade room	Maintenance	PS	411	2.6
loor 9, cascade room	Maintenance	PS	349	11
loor 9, cascade room	Maintenance	PS	374	2.8
loor 9, cascade room	Maintenance	PS	368	240[b]
Floor 9, cascade room	Maintenance	PS	367	3.3
Floor 9, cascade room	Maintenance	PS	333	2.7
Floor 9, cascade room	Maintenance	PS	328	5.9
Floor 9, cascade room	Patrolman	PS	446	3.5
Floor 9, cascade room	Shoveler	PS	435	32[b]
Floor 9, cascade room	Shoveler	PS	436	1.5
Floor 9, cascade room	Shoveler	PS	433	0.85

Evaluation Criteria[c]: 2 mg/M^3

a - BZ is breathing zone sample
PS is personal sample, employee wearing dust respirator.
See Section II

b - Cassette loaded with loose particulate material, value suspect.

c - ACGIH TLV's (1980), time-weighted average concentration for an 8-hour workday. The respirable dust fraction containing less than 5% quartz.

TABLE II

RESPIRABLE COAL DUST CONCENTRATIONS
DETROIT EDISON COMPANY - MONROE POWER PLANT
MONROE, MICHIGAN

January 31, 1980

SAMPLE DESCRIPTION				AIRBORNE CONCENTRATION OF RESPIRABLE COAL DUST mg/M^3
General Work Location	Job Classification	Type[a]	Duration (Minutes)	
Floor 1, unit 3	Asst. Power Plant Operator	BZ	450	0.99
Precipitators, Coal bunkers 3 & 4	Asst. Power Plant Operator	BZ	434	0.71
Floor 1, units 3 & 4	Asst. Power Plant Operator	BZ	439	0.11
Transfer house, coal yard	Patrolman	BZ	443	23[b]
C2-3 transfer house	Clean-up	BZ	416	1.8
C2-3 transfer house	Clean-up	BZ	429	0.72
C2-3 transfer house	Clean-up	BZ	436	0.60
Electrical shop	Maintenance	BZ	424	0.20
Floor 9, unit 2 IK-9	Maintenance	BZ	306	0.90[c]
Floors 9 & 10, unit 2	Maintenance	BZ	414	0.42
Electrical shop	Maintenance	BZ	378	0.21
General shop, houskeeping	Maintenance	BZ	358	1.9
Coal mills, pulverizers	Maintenance	BZ	334	0.40
Floor 9, cascade room	Patrol	PS	450	2.0
Floor 9, cascade room	Maintenance	PS	192	0.65
Floor 9, cascade room	Maintenance	PS	360	1.2
Floor 9, cascade room	Maintenance	PS	369	1.4
Floor 9, cascade room	Maintenance	PS	354	1.5
Floor 9, cascade room	Maintenance	PS	334	0.28
Floor 9, cascade room	Maintenance	PS	332	1.5
Evaluation Criteria[e]:				2 mg/M^3

a - BZ is breathing zone sample; PS is personal sample.

b - Cassette loaded with loose particulate material, value suspect.

: - Filter was damaged, value may be low.

d - Worker left at midshift

e - ACGIH TLV's (1980), time weighted average for an 8-hour workday. Respirable dust fraction containing less than 5% quartz.

TABLE III

RESPIRABLE DUST EXPOSURES FOR WORKERS EXPOSED TO FLY ASH
DETROIT EDISON COMPANY - MONROE POWER PLANT
MONROE, MICHIGAN

January 30-31, 1980

SAMPLE DESCRIPTION					AIRBORNE CONCENTRATION RESPIRABLE FLY ASH mg/M
Date	General Work Location	Job Classification	Type[a]	Duration (Minutes)	
1/30	Floor 9, cascade room	Maintenance	PS	404	4.4[b]
1/30	Floors 2-13, unit 1	Asst. Power Plant Operator	BZ	438	0.34
1/30	Floors 2-13, unit 2	Power Plant Operator	BZ	420	0.20
1/30	Floor 1, unit 2	Asst. Power Plant Operator	BZ	432	0.33
1/30	Floors 5 & 6, unit 4	Maintenance	BZ	529	0.22
1/30	Unit 1 & 2 coal mills	Maintenance	BZ	420	0.89
1/30	Floor 6 air units and precip.	Maintenance	BZ	522	0.37
1/30	Electrostatic precipitators	Maintenance	BZ	519	0.28
1/30	Electrostatic precipitators	Maintenance	BZ	534	0.57
1/31	-	Pipe insulator	BZ	343	0.55
1/31	-	Pipe insulator	BZ	373	0.90
1/31	Floor 2, feed pumps	Maintenance	BZ	384	2.7[b]
1/31	Floor 4, recirculation fans	Maintenance	BZ	331	0.21
1/31	Floors 2-13, unit 3	Power Plant Operator	BZ	460	0.32
1/31	Floor 1, unit 4	Asst. Power Plant Operator	BZ	444	0.53
1/31	Floor 1, units 3 & 4	Power Plant Operator	BZ	442	0.28
1/31	Floor 1, units 3 & 4	Power Plant Operator	BZ	425	0.14
Evaluation Criteria[c]:					5 mg/M^3

a - BZ denotes breathing zone samples; PS denotes personal sample, employee wearing respirator.

b - Evaluation criteria for samples noted is 2 mg/M^3, coal dust. (respirable dust fraction less than 5% quartz)

c - ACGIH TLV's (1980), time weighted average concentration for an 8-hour workday. Respirable dust fraction less than 1% quartz.

TABLE IV

BULK DUST SAMPLE RESULTS
DETROIT EDISON COMPANY - MONROE POWER PLANT
MONROE, MICHIGAN

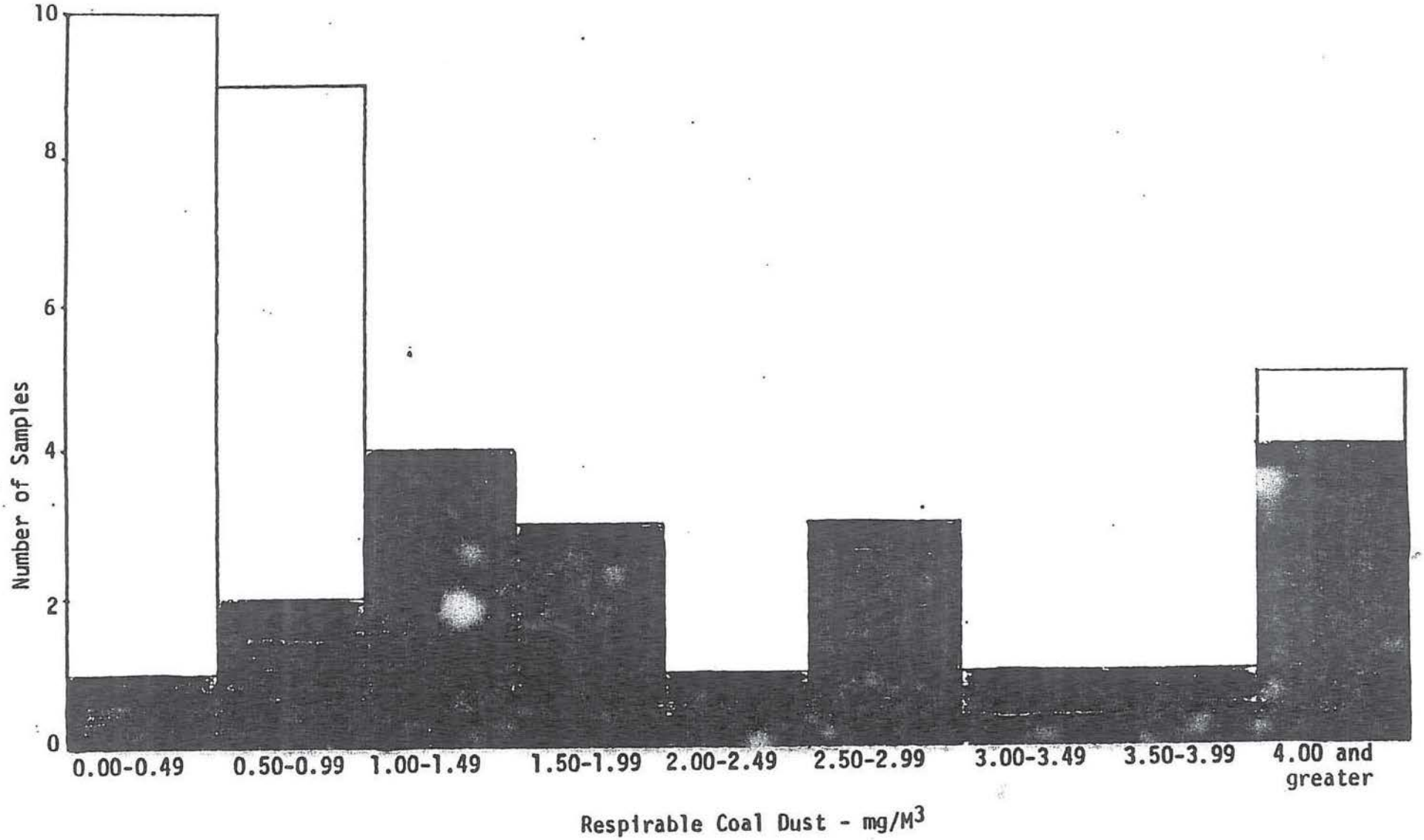
January 30-31, 1980

SAMPLE NUMBER	DESCRIPTION AND LOCATION	% BY WEIGHT		Metals, % by weight[b]						pH
		Quartz	Cristobalite	Na	K	Pb	Cd	Mg	As	(aqueous)
1	I-beam dust sample Floor 3	2.7	N.D.[c]	0.12	0.17	0.001	N.D.	0.28	N.D.	9.38
2	Coal dust sample Cascade room	1.4	N.D.	0.04	0.05	N.D.	N.D.	0.03	N.D.	7.88
3	Fly ash from electrostatic precipitator hopper	1.6	N.D.	0.16	0.12	0.003	N.D.	0.33	N.D.	11.54
4	Floor 9, ledge in Cascade room	1.0	N.D.	0.06	0.07	N.D.	N.D.	0.08	N.D.	9.27
Mean Value (±Std dev)		1.7 (±.4)	-	0.10 (±.04)	0.10 (±.06)	.004 (±.008)	-	0.18 (±.14)	-	9.52 (±1.49)

a - percent per 3 mg sample

b - percent per 250 mg sample

c - N.D.= none detected



Total Samples = 37

Shaded portion indicates number from cascade room.

Figure I
Respirable Coal Dust Concentrations

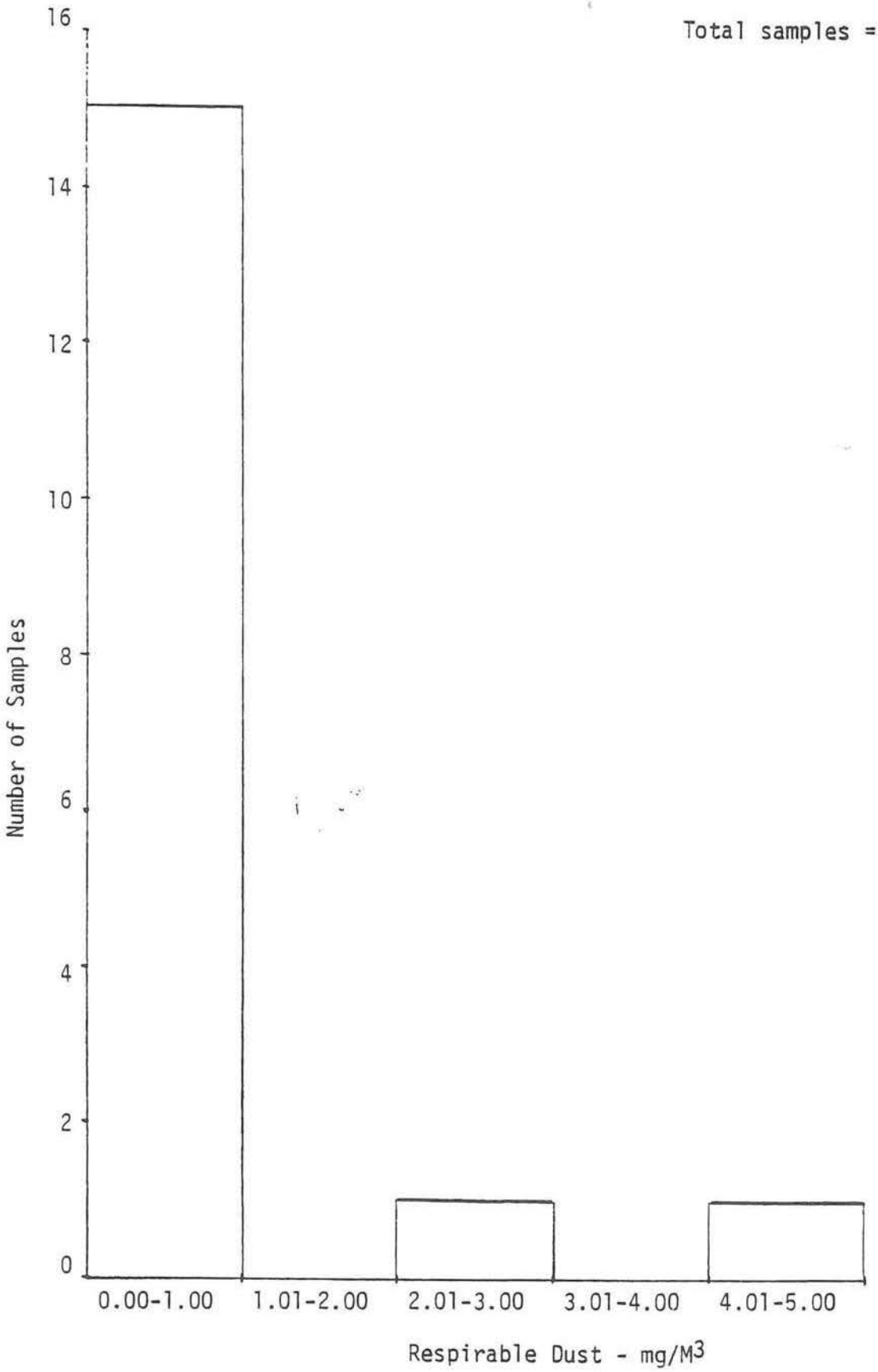


Figure II
Respirable Dust Concentrations

(Fly Ash)

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PUBLIC HEALTH SERVICE
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