FINAL REPORT

COAL DUST AND SILICA SURVEY

Crisp County Power Commission
Coal-Fired Power Plant
Cordele, Georgia

Survey and Report by:

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REGIONAL HAZARD SURVEY REPORT

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Abstract (Limit 200 words)

Environmental and personal air samples were analyzed for the presence of hazardous concentrations of coal and silica (7631869) dusts at the coal fired power facility of the Crisp County Power Commission (SIC-4911) in Cordele, Georgia, on July 12, 1978. The evaluation was requested by the management on behalf of an unspecified number of workers. Noise measurements also were taken. Airborne dust concentrations ranged from nondetectable to 0.15 milligrams per cubic meter (mg/cu m), well below the OSHA standards of 2.4mg/cu m for coal dust and 10mg/cu m for respirable dust containing quartz. Exposures to free crystalline silica were below the detectable limits of the sampling and analytical method. Noise readings ranged from 67 to 116 decibels (dB) at different locations. The OSHA standard for noise exposure is 90dB for an 8 hour daily exposure. The investigators concluded that coal and silica dust concentrations were not hazardous to workers at the time of the investigation, but that some workers were exposed to excessive noise. Recommendations were to wet the coal before it is loaded or moved, and to develop and enforce a hearing conservation program. Procedures for work in confined spaces also are recommended.

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I. Summary

The Crisp County Power Commission of Cordele, Georgia, operates a coal-fired power plant which provides part of the power requirements for this electric utility. A safety representative of the Commission requested the NIOSH regional office in Atlanta to provide technical assistance in evaluating the exposure of the plant employees to coal and silica dusts.

Daily average exposures to coal dust were found to be within acceptable limits. Exposures to free crystalline silica were below the detectable limits of the sampling and analytical method. Exposure levels of coal and crystalline silica dusts observed during the NIOSH survey are not considered hazardous to the health of the employees.

II. Introduction

A safety representative of the Crisp County Power Commission requested the NIOSH Region IV office to provide technical assistance in evaluating the exposure of workers to coal dust and silica at the Commission's coal-fired power plant. An industrial hygienist from the NIOSH Region IV office conducted the hazard survey on July 12, 1978. Coal dust exposure results primarily from the loading and feeding of the coal. Additional coal dust may be liberated from occasional leaks in the conveying or pulverization operations. Silica exposure results from the silica content of the coal and the fly ash.

III. Evaluation Criteria

The American Conference of Governmental Industrial Hygienists (ACGIH) publishes an annual list of guidelines for the protection of workers from airborne exposures to chemical substances.[1] This list is called the

list of Threshold Limit Values (TLV's), which are guidelines for exposure limits. ACGIH has defined the TLV as the time-weighted average concentration of a substance in air for a normal 8-hour workday or 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.
The 1977 TLV's for these substances are:

Coal dust (if the respirable fraction of the dust is less than 5% quartz)	2 mg/cu m*
Respirable dust (containing quartz)	$\frac{10 \text{ mg/cu m*}}{\% \text{ Respirable quartz} + 2}$

The current legal standard of OSHA for respirable dust containing quartz is the same as the ACGIH's TLV. However, OSHA's current standard for coal dust (respirable fraction less than 5% SiO_2) is 2.4 mg/cu m.[2]

Coal Dust[3]

Coal workers' pneumoconiosis (CWP), also known as miner's asthma, anthracosilicosis and "black lung", is a chronic condition that may be defined, in medical terms, as the accumulation of coal dust in the lungs and the tissue reaction to its presence. The disease is caused by inhalation of coal mine dust and is characterized by persistent cough, the production of sputum, and dyspnea (shortness of breath). Diagnosis is based upon a history of prolonged exposure to coal dust and typical roentgenographic (X-ray) patterns of dust retention in the lungs.

*mg/ cu m = milligrams of the substance per cubic meter of air

The basic lesion of coal workers' pneumoconiosis is the coal macule. The macule evolves by the incorporation of dust-filled macrophages (small phagocytic cells that engulf foreign particles) into the walls of respiratory bronchioles and adjacent alveoli. In many individuals, these bronchioles undergo dilatation and give rise to the condition known as focal emphysema. The radiological features of simple pneumoconiosis in coal workers are due to the dust itself plus small amounts of fibrous tissue; chest X-rays reveal neither the existence nor the degree of focal emphysema. Simple pneumoconiosis in coal workers shows identical features, and the same focal type of lesion, regardless of the rank of coal worked, that is, whether anthracite or bituminous.

Coal workers' pneumoconiosis usually takes many years to develop. Eventually, in severe cases, simple pneumoconiosis may progress to the complicated form of the disease -- progressive massive fibrosis -- in which there is widespread consolidation involving large amounts of dust enmeshed in connective tissue, typically in the upper parts of the lungs.

Silica

NIOSH, in its criteria document for crystalline silica[4], has recommended that a new occupational health standard be established to limit exposure to 0.05 mg/cu m 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 fibrous tissue

in the lungs caused by inhaling silica dust. Gradual lung changes associated with overexposure to free silica may go unnoticed for years. Detectable symptoms may not clinically be "seen" for 10 to 20 years.[5]

The amount of free silica in coal dust seldom exceeds 10% by weight and usually is less than 5%. Thus silicotic lesions are rare among coalworkers.[6]

Noise

Excessive exposure to noise may result in temporary or permanent hearing impairment. The present OSHA legal standard for noise exposure allows exposure to varying levels of noise for varying peridds of time as follows[2]:

Permissible Noise Exposures

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

NIOSH and ACGIH have proposed more stringent noise standards to provide a greater degree of protection from hearing impairment. The ACGIH TLV for noise[1] for 1977 is:

Duration per day, hours	Permissible Sound Level, dBA
16	80
8	85
4	90
2	95
1	100
1/2	105
1/4	110
1/8	115

IV. Evaluation Methods

Total airborne coal dust was measured by drawing air at a known and constant rate through a pre-weighed MSA Type FWS-B membrane filter. After sampling the filter was again weighed to measure the weight gain due to collected particulate matter, presumed to be coal dust. 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.

Personal exposure samples were collected from these employees by having them wear a battery-powered vacuum pump on their belts or in pockets connected by tubing to the filter held by a cassette and clip to clothing near the mouth and nose. Area samples were collected by placing the equipment at selected locations around the plant.

Respirable airborne coal and silica dust was collected by drawing air at a rate of 1.7 ± 0.15 liters per minute first through a 10 - mm nylon cyclone to remove the larger, non-respirable particles prior to collection of the respirable particles on a pre-weighed MSA FWS-B filter. The amount of collected coal dust was determined by re-weighing the filters after sampling. The amount of respirable free silica was determined by an X-ray diffraction method[7] after the filters had been re-weighed and then dissolved in tetrahydrofuran. Noise measurements were made throughout the plant using a General Radio Sound Level Meter.

V. Findings

The results of air samples for coal dust are shown in Table 1. All samples were found to be markedly less than the 2 mg/cu m limit. The air samples were analyzed, not for total silica (silicon dioxide), but for those forms of silica associated with silicosis. For this reason, the samples were analyzed for both crystalline type and silica content. Neither quartz nor cristobalite were found on any of the sample filters. The limit of detection was 0.03 mg per filter for either quartz or cristobalite. Therefore, it can be inferred that airborne silica, if present, was at concentrations less than 0.05 to 0.06 mg/cu m.

Three bulk samples of powdered coal and fly ash were also analyzed for silica content. The results are as follows:

	Quartz	Cristobalite
Powdered coal from the pulverizer #2	1.1%	less than 1.0%
Settled coal dust from the exterior surfaces of the #2 pulverizer	1.4%	less than 0.9%
Fly ash	4.1%	less than 1.0%

Quartz was found in the bulk samples, but cristobalite was not detected. The detection limits for cristobalite are indicated above.

The quantity of free silica in the respirable dust samples was too small to be detected by the analysis. The bulk sample of fly ash contained 4.1% quartz. If the assumption is made that airborne fly ash dust would also consist of 4.1% free silica, the standard for airborne fly ash would be calculated as follows:

Standard for Respirable Dust

Containing Quartz $\quad 10 \text{ mg/cu m} \div (\%SiO_2 + 2)$

$\% SiO_2 = 4.1$

Standard = 1.6 mg/cu m

All air sample results were considerably less than 1.6 mg/cu m, so the fly ash exposure did not appear to be excessive.

Other Observations:

1. It is anticipated that the amount of coal dust generation from the loading operation will be largely dependent on the moisture content of the coal pile. Less dust generation will be expected when the coal pile is wet than when it is dry. (The moisture content of the coal pile was not determined during this survey. There were heavy rainstorms in that area of Georgia the evening before the survey.)

2. Men who must perform occasional maintenance on the boiler and baghouse may be exposed to high concentrations of silica and sulfur dioxide unless properly protected.

3. Noise readings taken around the plant were:

Inside the control room	67 dBA
Outside the control room door (catwalk)	91-92 dBA
4 feet from #2 pulverizer	94-97 dBA
Boiler pump area (door to gas turbine house open)	93-95 dBA
Just inside the door of the gas turbine house	106 dBA
Beside the gas turbine	115-116 dBA

Personnel were observed working on the catwalk, around the pulverizer, and in the boiler pump area without wearing personal hearing protection.

VI. Recommendations

1. Insure that the coal to be loaded or moved is wetted beforehand

2. Prior to entry into a confined space[2] for boiler or baghouse maintenance, test the atmosphere of the space for oxygen and sulfur dioxide content. Always maintain appropriate controls and protective procedures before and during work in confined spaces[2], including appropriate respiratory protection. Only respirators approved by NIOSH

and MSHA and designed to protect against the hazardous substances and concentrations of concern should be used.

3. Whenever employees may be exposed to excessive noise, a hearing conservation program should be developed and enforced.
4. A handrail is needed on the building side of the stairs leading from the office and control room to the ground.

VII. References

1. "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment With Intended Changes for 1977", American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.
2. "General Industry Standards", OSHA Publication No. 2206, 1976
3. "Protecting the Health of Coal Miners", NIOSH Publication No. HSM 73-11015, 1973
4. "Criteria for a Recommended Standard.... Occupational Exposure to Crystalline Silica", NIOSH Publication No. 75-120, 1974
5. "Health and Safety Guide for Foundries", NIOSH Publication No. 76-124, 1976
6. Encyclopedia of Occupational Health and Safety, Vol. I, 307, International Labor Office, McGraw Hill Book Co., 1971
7. NIOSH Manual of Analytical Methods, Method No. P & CAM 109, NIOSH, 1974

VIII. Acknowledgements

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TABLE I

Air Sampling Results
Crisp County Power Commission
Coal-Fired Power Plant

Cordele, Georgia
July 12, 1978

tion/Job	Sampling Point	Type of Sample	Air Sampling Rate (Approx.) (liters per min.)	Sample No. (FWS-)	Start Time	Stop Time	Air Volume Sampled (liters)	Average Dust Concentration (Mg/cu m)
tenance nan	Working on boiler feed pump near pulverizer	Personal Exposure	1.85	2527	8:29 AM	3:03 PM	729	0.03
tenance er	Working on boiler feed pump near pulverizer	Personal Exposure	1.80	2512	8:30 AM	3:03 PM	707	0.01
Passer	Operating front end loader	Personal Exposure	1.75	2517	8:32 AM	3:03 PM	684	0.03
odian	Throughout Plant	Personal Exposure	1.80	2522	8:34 AM	2:54 PM	684	N.D.
erator	Working in control room	Personal Exposure	1.70	2530	8:35 AM	2:56 PM	648	N.D.
ol Room	On top of chart file in middle of room	Area	1.75	2515	8:45 AM	2:46 PM	632	0.08
ulverizer	On pipe beside pulverizer	Area	1.80	2520	10:00 AM	2:52 PM	526	0.15
Dumping	Where loader deposits coal	Area	1.85	2519	9:58 AM	2:50 PM	540	0.09

= none detected