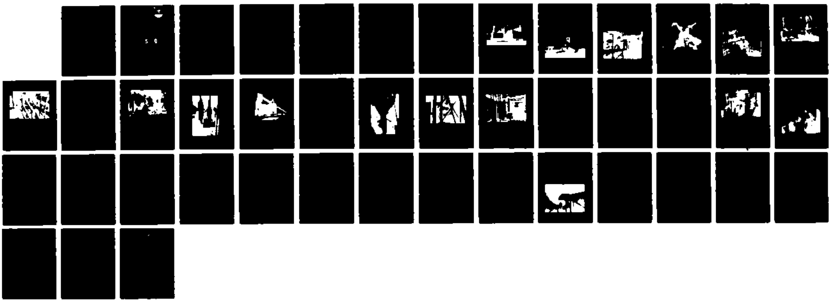
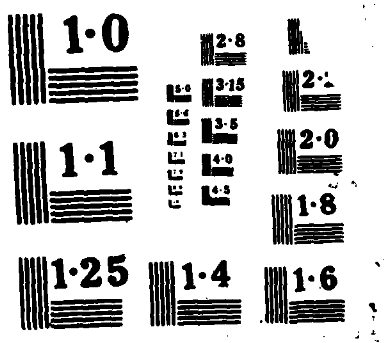
AD-A191 429 BASELINE INDUSTRIAL HYGIENE SURVEY AT THE COAL FIRED HEATING PLANT MALMST.. (U) AIR FORCE OCCUPATIONAL AND ENVIRONMENTAL HEALTH LAB BROOKS AF.. 1/1

UNCLASSIFIED F B LIEBHABER ET AL. DEC 87 F/G 6/9 NL




1·0
2·8
3·15
2·0
3·5
4·0
1·1
1·8
4·5
1·25
1·4
1·6

(2)

USAFOEHL REPORT

87-168EH0124MGA

Baseline Industrial Hygiene Survey at the Coal Fired Heating Plant, Malmstrom AFB MT

FRANK B. LIEBHABER, JR., Capt, USAF, BSC
KUL B. GARG, 1Lt, USAF, BSC

December 1987

Final Report

Distribution is unlimited; approved for public release

USAF Occupational and Environmental Health Laboratory
Human Systems Division (AFSC)
Brooks Air Force Base, Texas 78235-5501

NOTICES

When Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever. The fact that the Government may have formulated, or in any way supplied the said drawing, specifications, or other data, is not to be regarded by implication, or otherwise, as in any manner licensing the holder or any other person or corporation; or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The mention of trade names or commercial products in this publication is for illustration purposes and does not constitute endorsement or recommendation for use by the United States Air Force.

Do not return this copy. Retain or destroy.

Air Force installations may direct requests for copies of this report to: USAF Occupational and Environmental Health Laboratory (USAFOEHL) Library, Brooks AFB TX 78235-5501.

Other Government agencies and their contractors registered with the DTIC should direct requests for copies of this report to: Defense Technical Information Center (DTIC), Cameron Station, Alexandria VA 22314.

Non-Government agencies may purchase copies of this report from: National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield VA 22161.

The Public Affairs Office has reviewed this report, and it is releaseable to the National Technical Information Service, where it will be available to the general public, including foreign nations.

This report has been reviewed and is approved for publication.

JOHN J. COUGHLIN, Colonel, USAF, BSC
Commander

Prepared By:

FRANK B. LIEBHABER JR., Captain, USAF, BSC
Consultant, Industrial Hygiene Engineer

KUL B. GARG, 1Lt, USAF, BSC
Consultant, Industrial Hygiene Engineer

Reviewed By:

WILEY TAYLOR, Lt Col, USAF, BSC
Chief, Industrial Hygiene Branch

SHELTON R. BIRCH, Colonel, USAF, BSC
Chief, Consultant Services Division

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No 0704-0188

1a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

1b. RESTRICTIVE MARKINGS
N/A

2a. SECURITY CLASSIFICATION AUTHORITY
NA

2b. DECLASSIFICATION / DOWNGRADING SCHEDULE
NA

3. DISTRIBUTION / AVAILABILITY OF REPORT
Approved for Public release: distribution unlimited

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
87-168EH0124MGA

5. MONITORING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION
USAF Occupational and Environmental Health Laboratory

6b. OFFICE SYMBOL *(If applicable)*
ECH

7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS *(City, State, and ZIP Code)*
Brooks AFB TX 78235-5501

7b. ADDRESS *(City, State, and ZIP Code)*

8a. NAME OF FUNDING / SPONSORING ORGANIZATION
Same as 6a

8b. OFFICE SYMBOL *(If applicable)*

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c. ADDRESS *(City, State, and ZIP Code)*

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO	PROJECT NO	TASK NO	WORK UNIT ACCESSION NO

11. TITLE *(Include Security Classification)*
Baseline Industrial Hygiene at the Coal Fired Heating Plant, Malmstrom AFB, Montana

12. PERSONAL AUTHOR(S)
Capt Frank Liebhaber; Lt Kul Garg

13a. TYPE OF REPORT
Final

13b. TIME COVERED
FROM ________ TO ______

14. DATE OF REPORT *(Year, Month, Day)*
December 1987

15. PAGE COUNT
40

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*
Coal Fired Heating Plant, Malmstrom AFB

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

This report documents the occupational health conditions and exposures at the Malmstrom AFB MT coal fired heating plant so a baseline industrial hygiene monitoring program can be developed. Coal dust, ash, chemical, fugitive gas, noise, heat stress, and cold stress exposures were monitored. Results indicate the primary occupational health hazard was coal dust and ash exposure. This was especially true when the coal dust and ash silica content exceeded 5%. Hazardous noise levels were encountered throughout the plant. Potential chemical and heat/cold stress hazards were identified, but not considered significant at the time of the survey. [illegible]

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT
☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL
Capt Liebhaber, Frank

22b. TELEPHONE *(Include Area Code)*
(512) 536-3214

22c. OFFICE SYMBOL
USAFOEHL/ECH

CONTENTS

ILLUSTRATIONS

I. INTRODUCTION

A. Background:

1. HQ SAC/SGPB asked the USAF Occupational and Environmental Health Laboratory (USAFOEHL) to evaluate the potential industrial hygiene and environmental pollution problems associated with selected process steps in the new coal fired heating plants at Malmstrom AFB MT, F. E. Warren AFB WY, and Fairchild AFB WA. In January 1987, personnel from USAFOEHL conducted presurveys of the coal fired heating plants located at Malmstrom AFB MT, F. E. Warren AFB WY, and Fairchild AFB WA, to evaluate potential industrial hygiene and environmental pollution problems.

2. Our presurvey findings indicated the following:

a. The new heating plant at Malmstrom AFB MT required a complete baseline industrial hygiene survey.

b. The plant at F. E. Warren AFB WY did not require an additional survey. Low level exposure to coal dust and ash was an obvious problem adequately documented in the shop folder. Normal industrial hygiene monitoring should continue.

c. The coal firing of the heating plant at Fairchild AFB WA was suspended prior to our visit due to build-up of coal ash during ash transfer and disposal. Coal firing will resume once a suitable ash transfer auger-slurry maker is installed. There were no other outstanding industrial hygiene or environmental concerns.

3. In February 1987, we returned to Malmstrom AFB MT and conducted a baseline industrial hygiene survey. Ash and coal dust (total and respirable) exposures were measured throughout the plant as were the chemical and gas exposures during the desulfurization process, mixing of caustic solutions, and boiler off-gassing. Heat stress and noise exposure were also evaluated.

B. Purpose: Our purpose was to document occupational health conditions and exposures; and to recommend controls, procedures and personal protective equipment. The base bioenvironmental engineer would then use this information to develop a plant industrial hygiene monitoring program and for progress monitoring during follow-up annual surveys.

C. Survey Personnel:

Capt Frank Liebhaber, Industrial Hygiene Engineer
1Lt Laura Johrde, Industrial Hygiene Engineer
1Lt Kul Garg, Industrial Hygiene Engineer

D. Personnel Contacted:

Capt Burl Olson, Bioenvironmental Engineer
CMSgt Aldridge, Mechanical Systems Superintendent
Mr Pete Garrick, Coal Plant Operations Foreman
Mr Dave Broquist, Plant Engineer

II. PLANT AND PROCESS DESCRIPTION

A. Plant Description: The Malmstrom AFB MT Central Heating Plant is located in Building 82110, Figure 1.

Figure 1: Central Heating Plant

The plant was built by Brinderson Corp., Irvine CA, and was completed on 31 Oct 86. Normal operations began on 15 Sep 86, before the plant was officially declared complete. The plant produces hot water from three boilers. Most plant functions are monitored and controlled by the Bailey Network 90 Industrial Control System. Interface with this system is provided through two Operator Interface Unit (OIU) consoles located in an environmentally regulated control room.

B. Personnel: The heating plant operates on a three-shift, 24-hour basis with most maintenance and cleaning accomplished during the day shift. The day shift normally includes four control operators, two maintenance personnel, two floor operators, one coal yard worker, and one supervisor. On the swing and night shifts, there are two floor operators, two maintenance personnel, and two control operators.

C. Fuel: The plant can generate hot water by burning either gas or coal, or both. Gas is used during periods of low heat demand. When heat demand is high, it is more economical to burn coal. Since the physical and chemical properties of coal varies among mining sites; i.e., BTUs, silica, water, sulfur, ash and other noncombustibles, it's important to note that during the survey the plant used Western Sub-bituminous coal from the Big Horn Coal Mine, Sheridan WY. The plant is capable of burning 32 thousand tons of coal per year. The maximum plant capacity is 170 million BTU per hour (2 boilers at 100%).

D. Process Description and Potential Industrial Hygiene Concerns:

1. Coal Handling System. The coal handling system (Figure 2) has four components; rail or truck unloading area, coal receiving bunker, transfer and conveyance system, and storage bunkers.

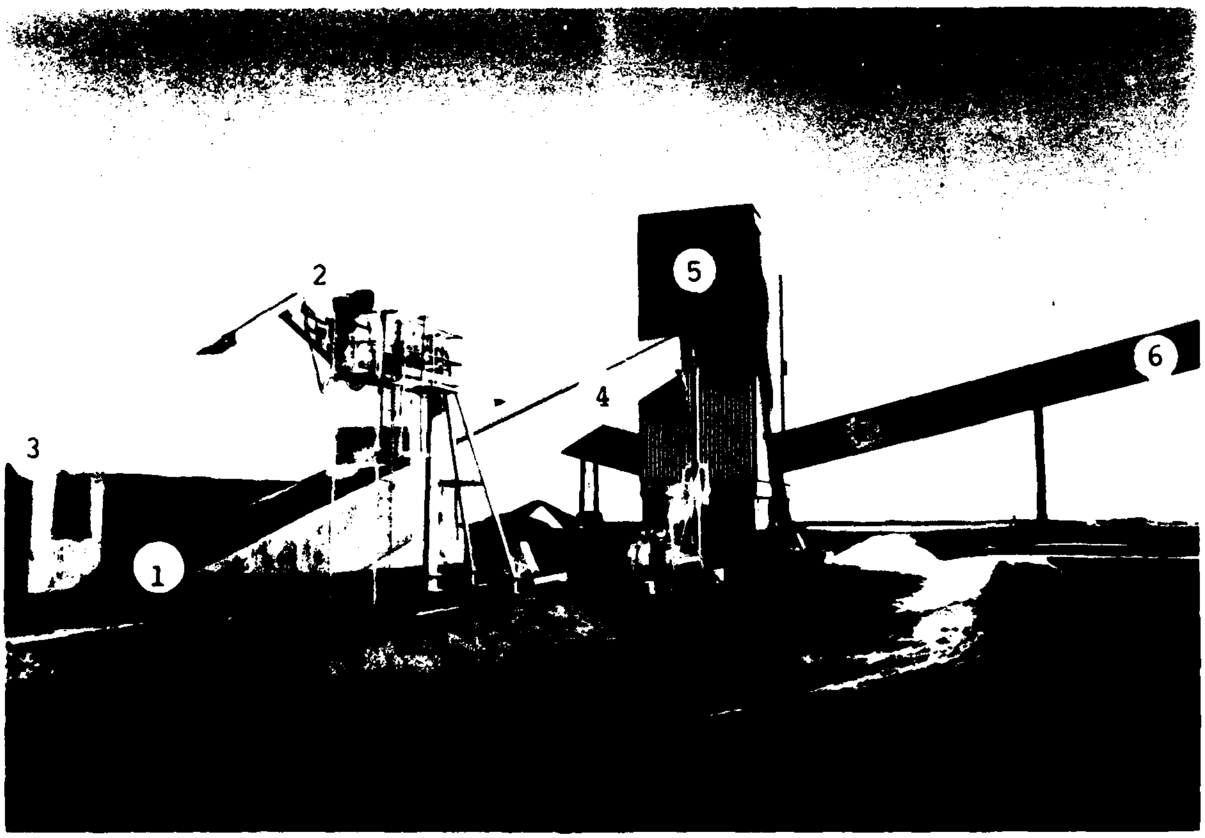


Figure 2: Coal Handling System

1. unloading area 2. articulated railcar hoe, operator's seat
3. coal receiving bunker 4. covered conveyor 5. transfer tower
6. conveyor to coal storage bunkers in plant

a. Coal is delivered by truck, or rail to the coal storage facility (coal pile) which has a 32 thousand ton capacity, a one year supply. Coal is downloaded from railcars into the coal receiving bunker by opening the railcar hopper gate, releasing coal into the coal bunker's vibrating feeder. The coal then moves on the conveyer to be used immediately or stored next to the plant. An articulated hoe, elevated over the railcar, can be used to help empty the rail car. A front-end loader is used to move coal around the coal pile. While using the front-end loader, the operator is protected from weather and coal dust by the loader's enclosed cab. The railcar unloader is not as fortunate or protected; especially when operating the elevated hoe. Dust and cold weather conditions make the job dirty, undesirable and potentially dangerous for the coal yard workers.

b. Coal dumped into the vibrating feeders moves through a hopper and deposits on the conveyor system, Figure 3.

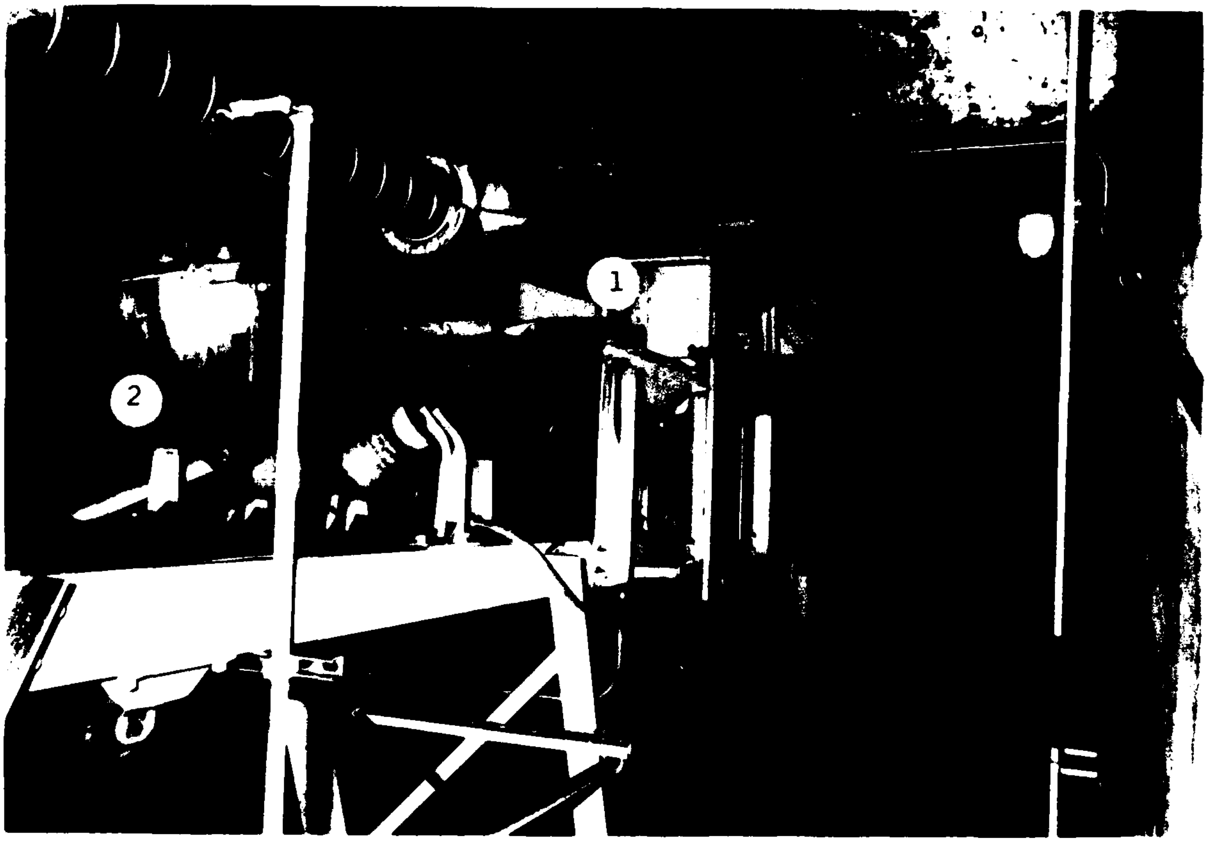


Figure 3: Coal Bunker's Vibrating Feeder
1. Dust recovery system 2. Conveyor

Each conveyor belt is provided with belt wipers and a plow. These devices prevent a build-up of material on the belt. The feeder/hopper system is enclosed in a bunker which escalates the dust and noise environment. The conveyor system is semi-open, dusty, and noisy, Figure 4.

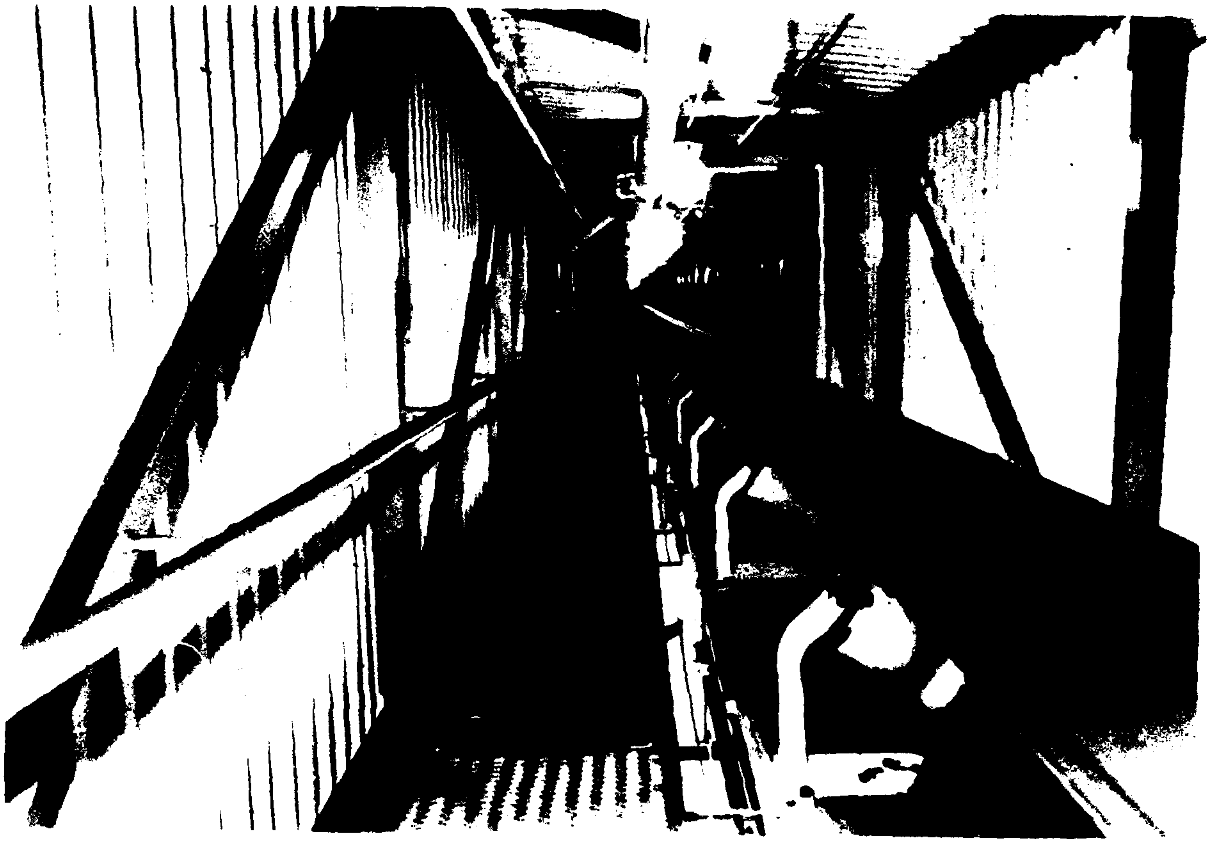


Figure 4: Semi-open Conveyors

c. To reduce airborne coal dust, there is a dust recovery system installed at transfer points in the reclaim and rail hopper area and conveyors, Figures 5 and 6. Recovered dust is returned to the coal pile.

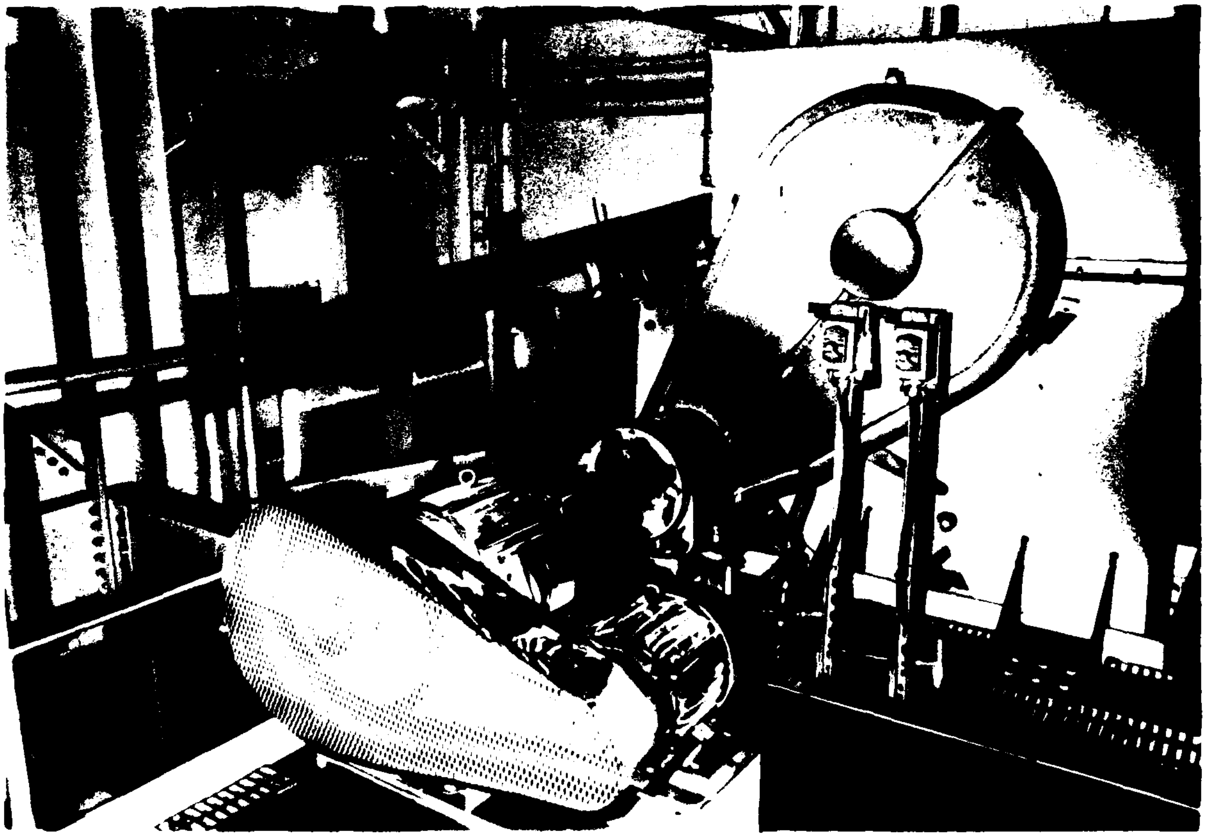


Figure 5: Coal Transfer Point, Top of Transfer Tower

Figure 6: Coal Transfer Points; Mid-tower
1. To plant 2. To coal pile

The dust recovery system does not perform efficiently. The obvious presence of coal dust throughout the coal transfer areas, Figures 5, 6 and 7, is indicative of the inadequacy of the dust recovery system. Whenever coal is transferred, coal dust smothers the conveyance system and housing, covering all exposed surfaces. Housekeeping is a continual problem during coal operations. (These pictures could not be taken during coal transfer because of the impenetrable dust cloud, not to mention the extreme inhalation hazard.) Workers loathe entering the coal transfer bunker, conveyor area or transfer house during operations due to excessive coal dust; however, it's usually not required.

Figure 7: Transfer Point; Mid-tower

d. Through the Operator Interface Unit (OIU) in the control room, the plant operator can control the conveying system automatically, or it can be switched to manual mode. Normal operation is automatic mode. Numerous interlocks are provided to insure all the equipment is operating properly.

e. Coal is conveyed, via transfer system, to storage bunkers above the boilers for future use in the boilers, or properly termed High Temperature Water Generators (HTWG). The bunkers are equipped with emergency discharge chutes in case of fire. Once coal is transferred to the bunkers, it ceases to contribute to the coal dust problem.

3. Combustion Air System.

a. Except for start-up, shut down, fine-tuning and minor adjustments, the combustion control devices are controlled automatically by the main control system. The control system regulates the amount of fuel and air present in the boiler to produce a constant outlet temperature necessary for combustion. This system includes under-fire air, over-fire air, coal feeders, gas burners and soot blowers. The combustion air system presents no industrial hygiene problems, other than the noise its pumping generates.

b. Coal, from the storage bunkers, is fed through the coal feeders above the stoker grate into the combustion chamber of the generators. Occasionally, coal gets jammed in the feeders and frantic efforts are employed to free the feeder before the fire burns out. This crisis increases the potential for infrared energy and fugitive gas exposure, and heat stress. During gas firing, the feeders are stopped.

c. Soot blowers remove soot from heat exchange surfaces in the upper part of the generator. This pneumatic process is automatically done during coal combustion and its action forces some ash and gasses out of the generators. While this system may decrease maintenance and soot cleaning of the heat transfer elements, it does not abolish those requirements.

4. Flue Gas System. When the HTWGs are coal fired, flue gas with fly ash, passes from the generator to mechanical collectors. Collectors remove heavier fly ash which is either transferred to the ash handling system or recycled into the HTWG through the fly ash reinjection system. Flue gas passes from mechanical collector into the air heater where the heat from the flue gas is transferred to the combustion air. Flue gas passes from the air heater to the desulfurization system, and finally into the bag filters (bag house). The bag filters remove fly ash not collected in the mechanical collectors. Flue gas then exits through the flue gas stack. Flue gas, with its high temperature and multiple toxic components, is a primary industrial hygiene concern. However, as observed, the flue gas system is fairly tight and seems to control the hazards well. The only exception may be during its maintenance, when workers have to open and enter the system's hardware.

5. Ash Handling System.

a. There is a pneumatic ash transfer system, that removes recovered ash from the HTWG's grate ash hopper, bottom ash hopper (Figure 8), mechanical flue ash collector, and bag filters. Large to medium sized ash is recovered in the primary and secondary cyclone collectors and deposited into the waste ash silo. The fly ash which passes through the secondary collector is collected in the bag house filters, which then routes it to the waste ash silo. Cleaning out plugged ash lines and filters near the vacuum pumps, Figure 9, is a routine maintenance occurrence and contributes significantly to the ash inhalation hazard.

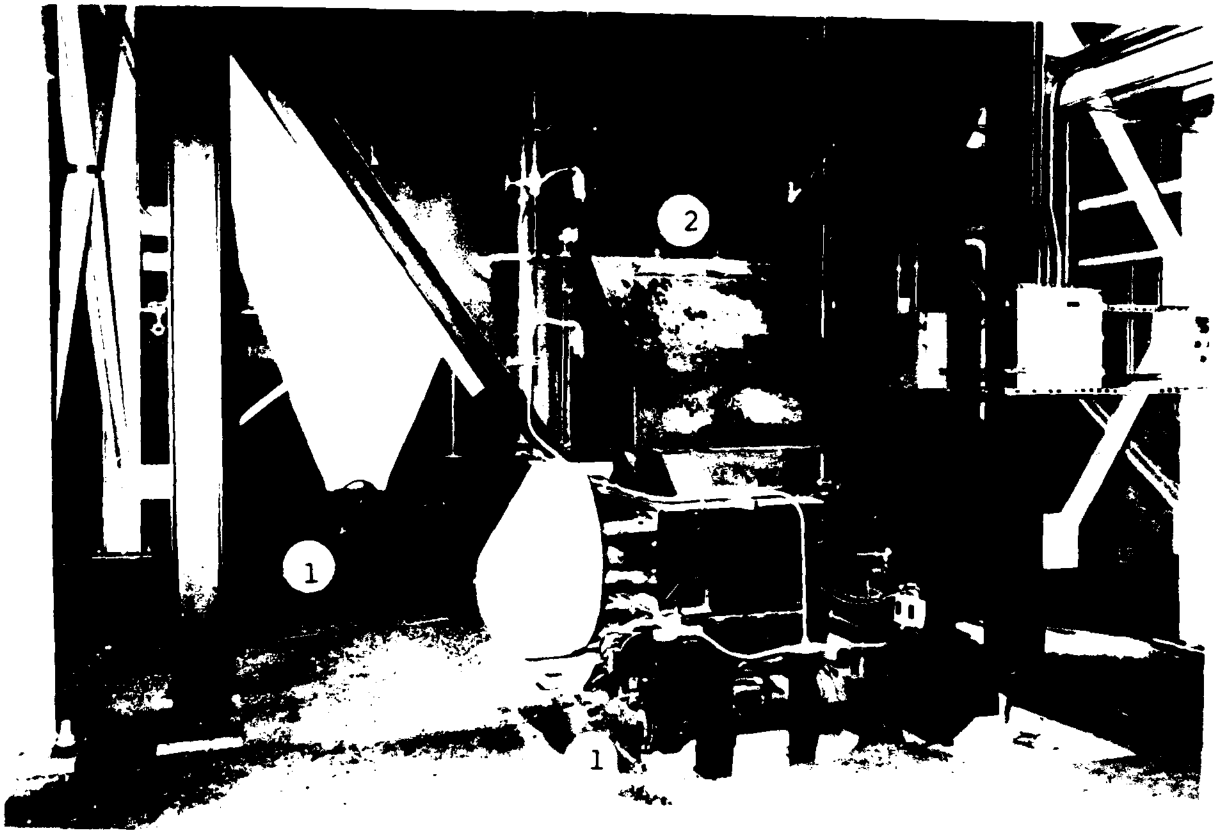


Figure 8: Ash system
1. Pneumatic transfer line ends 2. HTWG bottom ash hopper

b. There are five bag filter cells in the bag house. The main control system provides systematic cleaning, by pulse-jets, of each cell when the pressure drop across the cell becomes excessive. One cell at a time is cleaned while the other four continue operating. Bag filters must be replaced every four or five years. There were no hazardous exposures in the bag house area; however, during bag house entrance and maintenance (i.e., bag changing every 4-5 years), ash exposure and heat stress can create health hazards.

c. Periodically, the waste ash collected in the holding silo is purged for disposal. A dustless unloader transfers the ash from the silo into a chute and to a dump truck below. The dustless unloader, Figure 9, is a large screw-type material handler, designed to blend ash and water together forming a dustless, lumpy and damp ash aggregate. This system does not always mix properly. The processed ash composition can vary considerably, ranging from a powder to a slurry depending on unknown factors which effect the mixture. When the mixing is not optimum, large clouds of ash can be present during transfer; enveloping the truck and driver, and blowing towards the air intake for the control room's ventilation system. The workers doing the transfer, try to stay upwind and clear of any developing ash cloud, Figure 10.

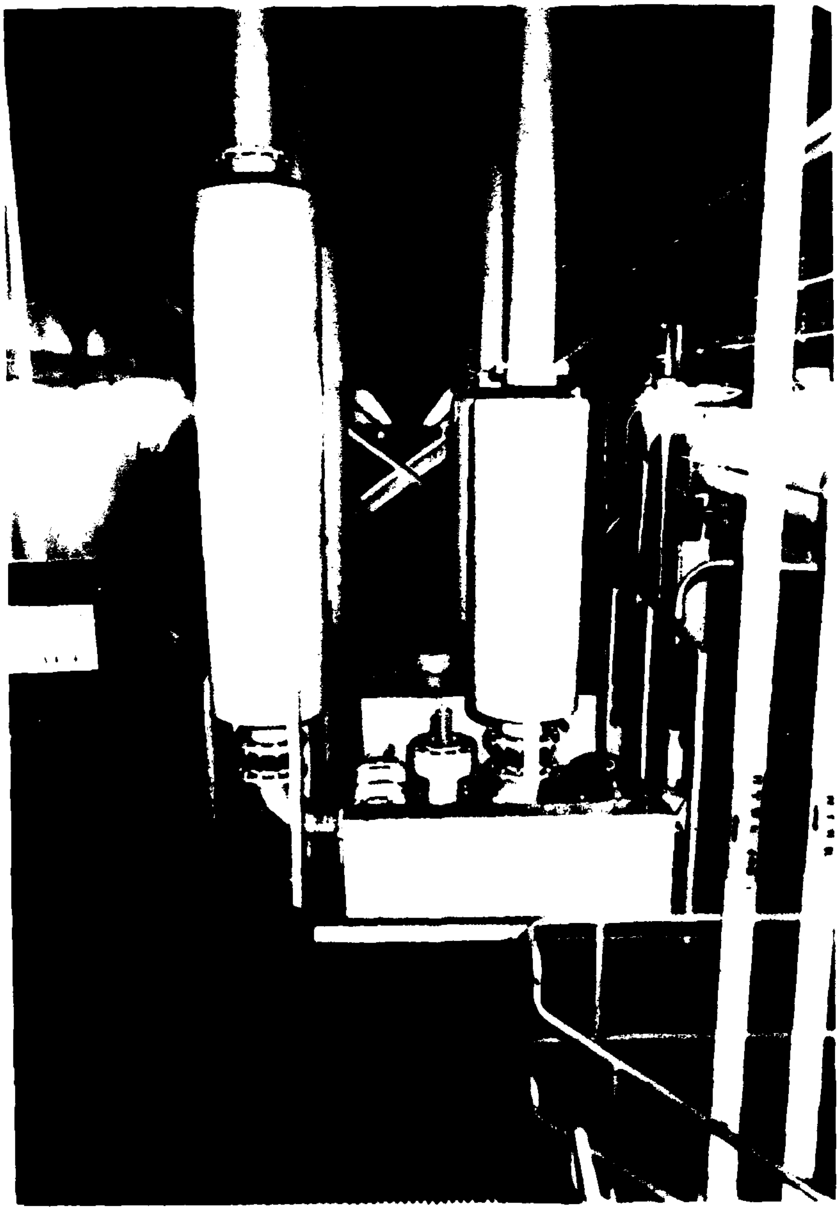


Figure 9: Vacuum Pumps
Dustless Unloader background; Vacuum Air Pumps, foreground

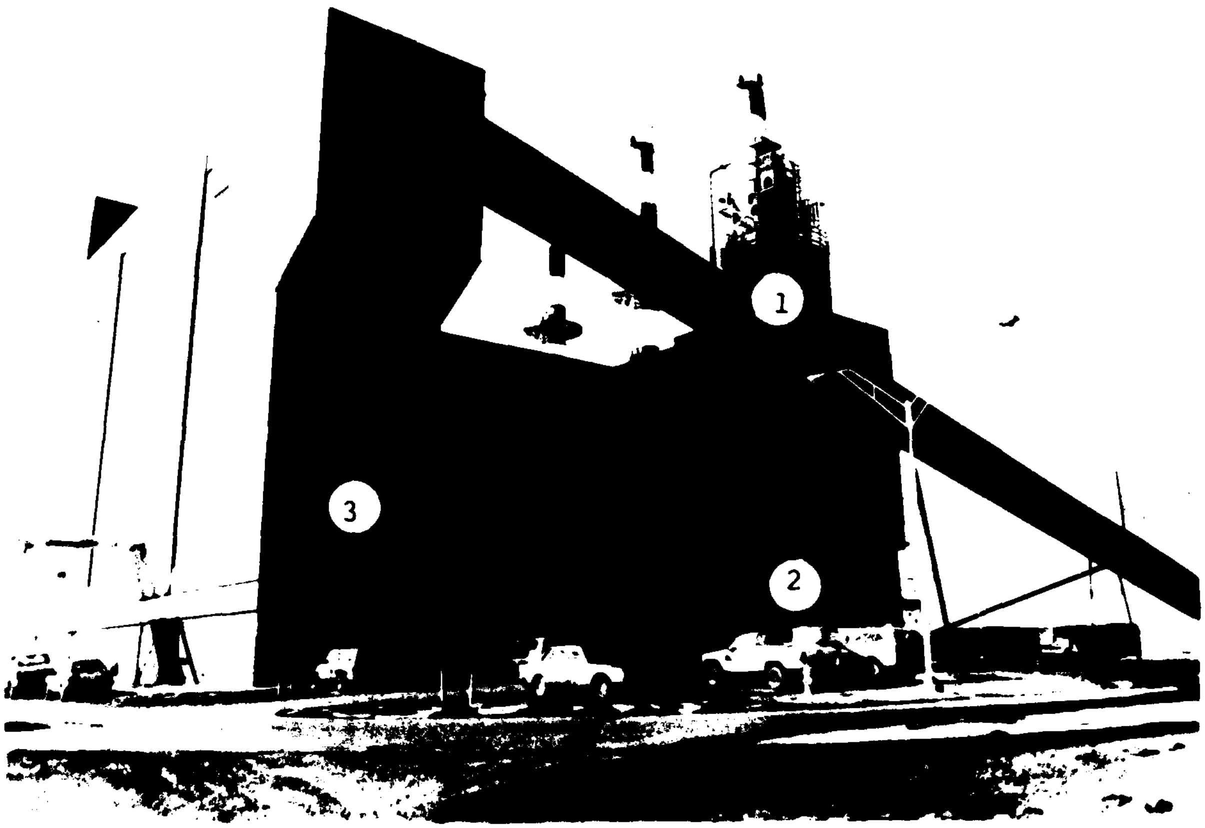


Figure 10: Waste Ash Transfer
1. ash silo 2. ash dump chute 3. ventilation air intake

6. Flue Gas Desulfurization System (SDS).

a. Flue Gas. Flue gas is desulfurized prior to being routed to the bag houses by treating it with a neutralizing adsorbent called "milklime." Milklime is an alkaline feed slurry made by mixing quicklime (calcium oxide), ash and water. In a spray dry reaction vessel, the flue gas SO_2 reacts with the milklime to produce calcium sulfate and sulfite. These reaction products dry, then fall to the bottom of the reaction cyclone along with excess fly ash and unreacted lime. All vessel bottom products are routed to the waste ash silo by conveyor. The treatment and evaporation process cools the flue gas to 161°F before it exits to the bag houses.

b. Spray Dry Absorber/Collection Cyclone. This reaction and scavenging vessel is prone to severe caking. This presents several hazards. Inspection inside the cyclone for built-up ash cake is required every couple of coal burning days; more if the coal sulfur content is high. A worker is lowered by crane, harness and cable through a manhole into the top of the vessel. This is both dangerous and difficult to do while wearing a respirator. When the cake is determined to be too thick for efficient absorber/cyclone operation, it must be removed. An expedient method of removing the cake is to use a shotgun and through a side manhole, fire a couple of shots into the vessel. This practice is not routine for a coal fired heating plant, but was suggested by the European manufacturer of the spray dry absorber. A substitute method must be found.

Once the cake is loosened, it falls to the bottom of the vessel, where many times it plugs the ash evacuating system. This makes it necessary to enter the vessel through a bottom manhole, Figure 11, and shovel the collapsed cake out the manhole, where it will be collected by wheelbarrow and taken outside. This is an extremely dusty job, both for the in-vessel worker and the wheelbarrow worker. A full face approved dust respirator is worn by the in-vessel worker and a disposable dust mask by the wheelbarrow worker. The area, Figure 12, was not designed for this type of routine unplugging, hence there is neither local exhaust ventilation, nor central vacuum.

c. Ash/Lime Slurry. Mixing or "slaking" quicklime (calcium oxide) with water to form milklime (calcium hydroxide) slurry is done by batch processing with a large mixing vat (similar to a concrete mixer with metering device) called the "slaker." A batch of milklime must be made about every 3 to 4 coal burning days. Slaking the quicklime with water is done semi-manually, creating the possibility of contact exposure to the quicklime dust and the caustic milklime slurry. Contact is minimized by wearing government issue foul weather gear. Overflow from the slurry tanks pools on the floor and drains into the local sewer system. Following coal burning shut-down, the slaker is drained and cleaned outdoors, but the slurry holding tanks must be drained and entered for cleaning, Figure 13. This represents a major contact hazard.

7. Water. High temperature water and treated make-up water systems move heat-exchanger water through two distribution systems. Together they move 3150 gallons of water per minute through each active boiler. The make-up water tank receives treated water and pumps it to the deaerator tank where dissolved oxygen is driven off. A cooling water system cools mechanical equipment and is the source of water for boiler water make-up, the ash silo dustless unloader, the waste water treatment educator, and slaking quick-lime. Cooling water not used for these processes is discharged. These systems pose little hazard other than when manually mixing in chemicals for water treatment.

Figure 11: Dry Spray Absorber/Cyclone
1. bottom manhole 2. ash evacuation system

Figure 12: Area Beneath Spray Dry Absorber/Cyclone

Figure 13: Slaking Room
1. slaker 2. slurry tanks

8. Vacuum Cleaning System. A central vacuum system is available in the main plant building for general housekeeping. There is no central vacuum system in the coal transfer and desulfurization buildings. This is unfortunate because it's these buildings that need the majority of clean-up.

9. Coal Grinding and Sizing. For EPA emission compliance, sulfur content samples are needed each time fresh coal is delivered. These bulk coal samples require pulverization prior to submission. Pulverizing coal for samples was not being done during this survey because the process produces large amounts of airborne dust. Excessive noise may also be generated. However, future EPA compliance sampling will be required and pulverization will commence once a solution is worked to control the dust.

10. Instrument Air, Plant Air, Make-up Air.

a. Instrument air and plant air are furnished by compressors and distributed at 100 psig and 150 psig, respectively.

b. Make-up air for the entire plant is brought in through six make-up air heaters located at ground level; air louvers with shut-off dampers and high temperature water heating coils. The make-up air for the control room is provided by vents located directly downwind of the ash unloading area, creating a situation which may expose the computer equipment to fugitive waste ash.

11. Noise. The plant had less noise during gas firing than during coal burning. This is due to the extra mechanical equipment required to move the coal and ash. During heat generation, most of the noise generating equipment in the plant operates intermittently, but frequently. All the operators and maintenance personnel use plugs or muffs when on the floor and near a noise source. Maintenance workers rarely stay in any one area for extended periods. There were no hazardous noise area warning signs posted in any area of the building, nor on any noise generating equipment.

12. Miscellaneous.

a. Fugitive gas. H_2S, CO, NOX and SO_2 are produced during normal operations. Most off-gassing is controlled, such as flue gas, and any gas that does escape, dissipates through dilution with plant air.

b. Cold Stress. The coal yard operators are primarily the employees vulnerable to this stress. There are no other prolonged outside activities.

c. Heat Stress. Heat stress may be a concern during summer inspections of the steam pits, and during maintenance in confined areas, such as HTWGs, holding tanks and reaction vessels. The steam pits are now maintenance free, but a worker still has to routinely inspect them. The other confined areas will require down-season maintenance. Summer temperature data must be collected.

d. Environmental Differential Pay. All plant personnel receive 4% EDP for dirty work. When dealing with coal combustion, soot, coal dust and ash contact is inevitable. Good personal hygiene is required. There are washrooms, but no shower facilities in the plant.

e. Maintenance duties. Routine maintenance duties expose workers to oils, lubricants, and paints. The small amounts of these agents used limit their hazard potential.

f. Welding. There are currently no welding operations in the plant.

g. Asbestos. There is no asbestos in the plant.

h. Illumination. Lighting was not addressed in this survey, but appeared adequate. All illuminares were clean and working.

i. Water Chemicals. Chemicals used for water treatment are:

sodium chloride (salt)- regenerate water softeners
sodium sulfate - boiler water oxygen removal
sodium hexametaphosphate - scale control
sodium hydroxide (caustic soda) - pH control in boiler water and regenerating dealkalizers.

j. Laboratory. Small amounts of chemicals are used in the laboratory to test the boiler water for scaling minerals and pH. The lab is also responsible for the other two boilers on base. Hardness and alkalinity are checked with colorimetry. Laboratory quality control is routinely checked by an outside organization.

k. Eye Hazard. Intense fires, such as the ones in the boilers, produce infrared energy that can be hazardous to eyes. Prolonged eye exposure to coal fires should only be done with the protection of viewing glasses specifically designed to reduce the transmitted infrared energy. The workers had and used such a viewing aid.

13. Personal Protective Equipment. With the exception of the milklime slakers and SDS vessel cleaners, the appropriate and adequate protective equipment was being worn by the workers during hazardous duties.

a. Laboratory:

Rubber laboratory apron
surgical gloves
rubber gloves (Class 2, Type 1, Norton)
goggles
safety glasses

b. Fire Safety Equipment: jackets and gloves

c. Respirators:

3-M 9901 Dust Mist respirator (TC-21C-247)
Full facepiece respirator - Ultra Twin MSA with filter cartridge Type H
Chemical cartridge GMA/MSA Organic Vapor
Disposable nuisance dust respirators

d. goggles

e. face shields

f. hand held aluminum face shields with infrared viewing glass

g. chemical mixing gloves, black rubber

h. surgical gloves, latex

i. cloth coveralls

j. hard hats

k. steel-toed shoes

l. disposable EAR Plugs

m. ear muffs (headsets)

n. foul weather gear

III. EXPOSURE MONITORING PROCEDURES

A. Air Sampling - Coal and Ash Dust

1. Background. Respirable particulate mass refers to particles that can penetrate a separator whose size collection efficiency is described by a cumulative log-normal function with a median aerodynamic diameter of 3.5 ± 0.3 micrometers (μm) and with a geometric standard deviation of 1.5 ± 0.1um. Total dust refers to all particles that cannot penetrate a separator whose size collection efficiency is determined by a 0.8 μm pore size matched weight filter

2. Methods: Each employee was monitored for total and respirable coal dust during their full shift, usually two 4-5 hour samples. The sampling cassette was positioned in the employee's breathing zone, and the pump, operating at 1.7 liters per minute (lpm), was positioned in the back pocket, Figure 14. To collect respirable dust, a Du Pont Alpha I personal sampling pump was used with a closed-face (37 mm) cassette containing 0.8 μm pore, matched weight filters in series with the 10 millimeter nylon cyclone. The same setup was used for total dust except that the cyclones were not present, and the cassettes were open-faced. General area monitoring was done with the total dust sampling train, cassettes pointing down.

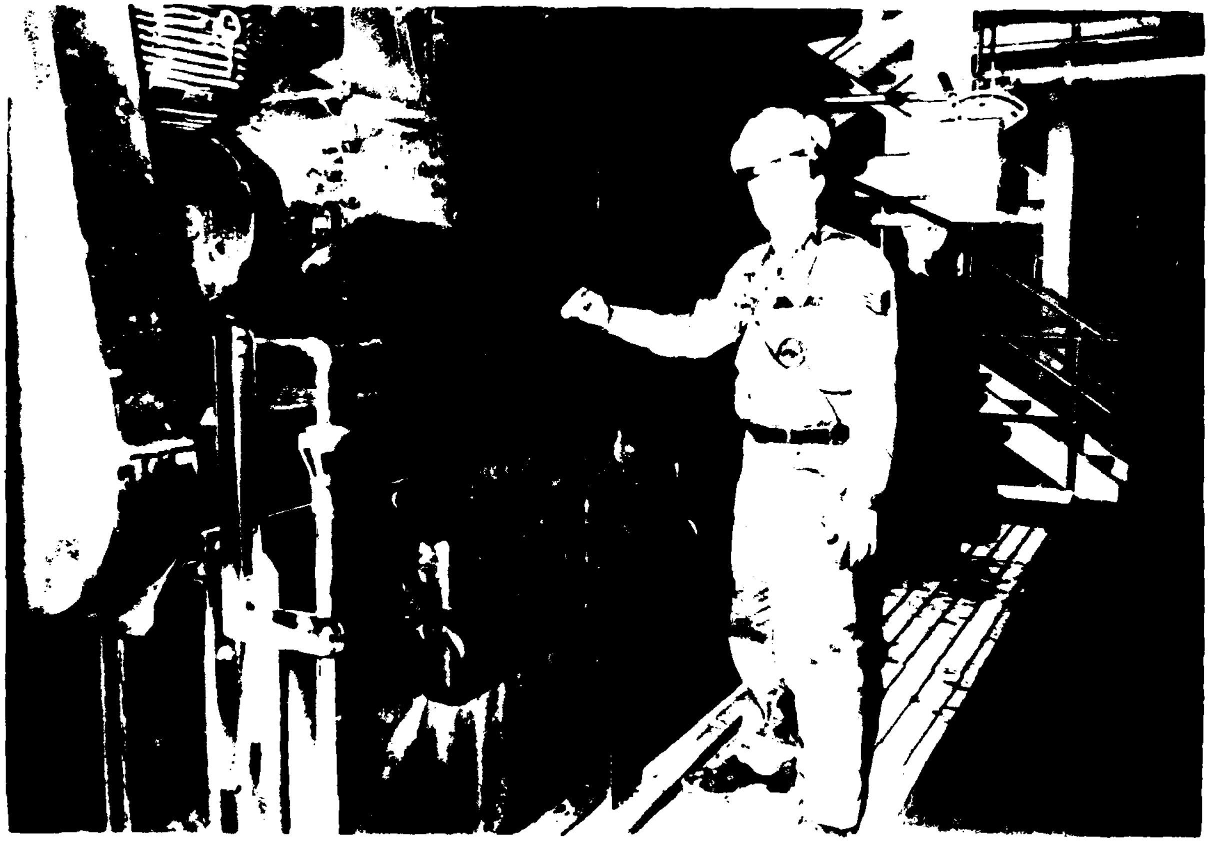


Figure 14: Worker With Dust Sampling Trains; Also Note Noise Dosimeter

3. Personnel evaluated. The coal yard operators normal shift is primarily outdoors during coal delivery and transfer. We monitored the front-end loader during yard coal transfer; we did not have the opportunity to monitor a delivery, nor the use of the articulated hoe. The plant's floor operators, and maintenance personnel (day, swing and night shifts) were monitored for the duration of their entire shift, throughout the entire facility.

4. Processes monitored. We sampled during normal heat season, routine duties such as: coal transfer, boiler light up, general operations, SDS hopper inspection and cleaning, ash line unplugging, lime slaking and waste ash disposal.

5. Locations monitored (area sampling): General area samples were taken on the coal scale floor, near conveyor No. 4, in the coal yard unloading area, transfer house, ash silo, and control room.

B. Air Sampling - Chemical Dusts

1. Procedure. The same sampling train used for coal dust was also used for quicklime dust during slaking. A similar sampling train was used during the mixing of sodium sulfite for water treatment, except a pump flow rate of 2.0 lpm was used due to the short process time. Mixing the solution took six minutes. Filters were positioned in the breathing zone of the workers.

2. Personnel and Processes Monitored. Floor operators and maintenance personnel exposures during the slaking process were evaluated for calcium oxide. For the mixing of sodium sulfite (evaluated as sodium), the sampling train was placed on the laboratory supervisor, who routinely does the chemical mixing, Figure 15.

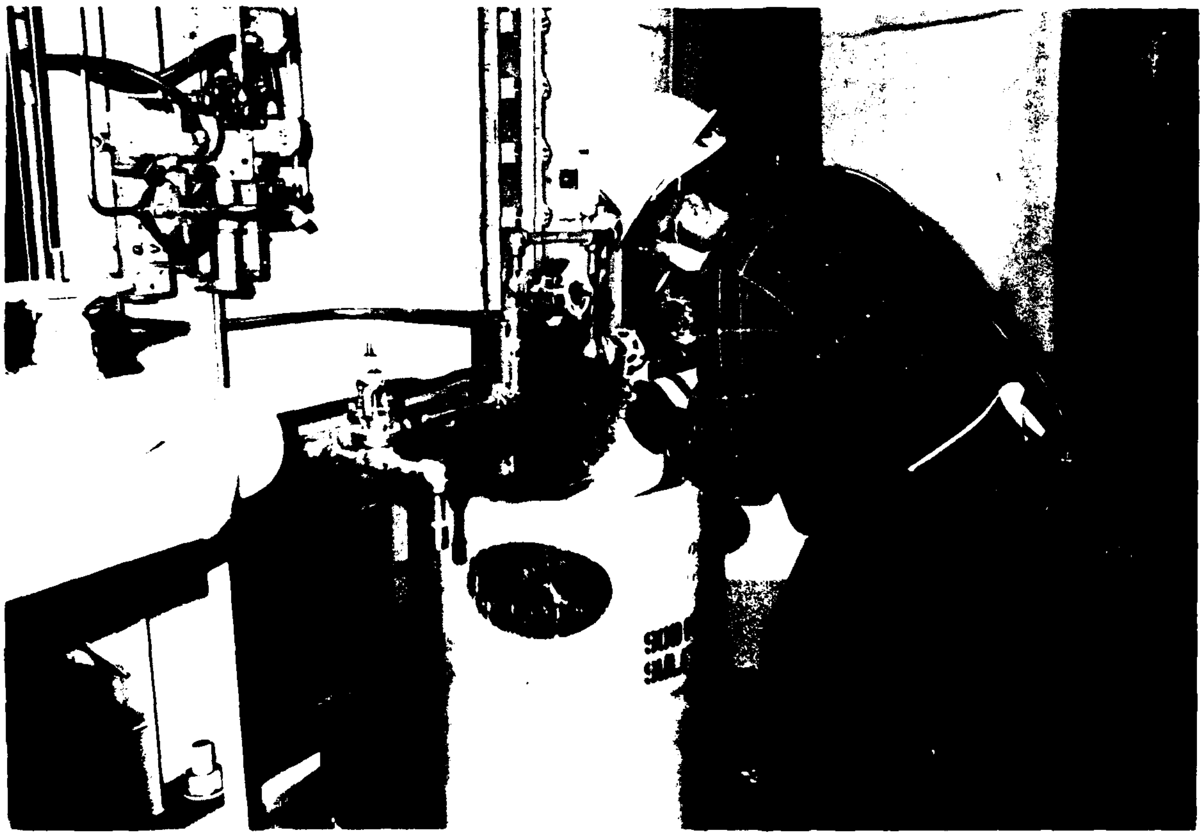


Figure 15: Sodium Sulfite Solution Mixing

C. Fugitive Gasses. Drager direct reading detector tubes were used to evaluate NO_x, SO_x, CO, and H_2S exposure. Readings were taken throughout the plant during routine operations. Ambient air was sampled in areas that had potential for fugitive gas release, i.e., near boilers during soot purging, during episodes that required opened inspection traps, and on catwalks near the flue gas ducting and stacks.

D. Noise. A General Radio Sound Level Meter, set on A-weighting and slow response, meeting the specifications listed in American National Standards Institute (ANSI) Standard S1.4-1971 (R1976) was used to measure noise levels generated by various equipment, and the noise levels in various areas of the power plant. Du Pont MK-1 noise dosimeters were placed on floor operators, maintenance personnel, and laboratory supervisor, during day, swing and night shifts. Microphones were clipped to the employees' collars.

E. Temperature. Sling psychrometers were used to measure the temperatures and relative humidities throughout the plant and during outdoor work.

IV. EXPOSURE STANDARDS

A. Airborne Contaminates. The American Conference of Governmental Industrial Hygienists (ACGIH) 1987-88 (1), Threshold Limit Values (TLV)^R of the monitored substances are listed in Table 1 as 8 hour Time Weighted Averages (TWA) and 15 minute Short Term Exposure Limits (STEL).

TABLE 1
EXPOSURE STANDARDS

SUBSTANCE	TWA (mg/m^3)	STEL (mg/m^3)	NOTES
coal dust, <5% quartz	2		respirable dust
coal dust, >5% quartz	0.1		respirable dust
ash, <5% quartz	10		total dust
ash, >5% quartz	0.1		respirable dust
sodium hydroxide	2		ceiling
Sulfur dioxide	5	10	
nitrogen dioxide	6	10	
hydrogen sulfide	14	21	
Carbon monoxide	55	440	
calcium hydroxide	5		
calcium oxide	2		

B. Noise Standards: AF Regulation 161-35, Aerospace Medicine: Hazardous Noise Exposure, 9 April 1982, describes policies, noise exposure standards, monitoring audiometry program, and coordination of Air Force activities in noise abatement.

1. General Noise. Hazardous noise is sound pressure of an intensity that exceeds an 8 hour TWA of 84 decibels, A-weighted (dBA). Workers must wear hearing protection when exposed to hazardous noise, levels >84 dBA. - Acceptable noise exposure limits are A-weighted overall sound levels coupled to specified time periods that do not damage the hearing organs, don't degrade work performance and avoids unwanted responses of the whole human body. Table 5 of AFR 161-35 contains these limits for exposures during a workday.

2. Hazardous Noise Areas. A work area is noise hazardous when the ambient sound pressure level and its duration exceed the values in AFR 161-35, Table 5. All hazardous noise areas must be clearly identified by signs located at their entrances or borders. Signs should be about 8 1/2 inches x 11 inches, or larger if needed and must have the message: CAUTION HAZARDOUS NOISE AREA MAY CAUSE HEARING LOSS HEARING PROTECTION REQUIRED. Each tool or piece of equipment that can produce sound levels greater than 84 dBA at the operator position shall be clearly marked to alert personnel, except in a case when an entire area is designated a noise hazard area and the tools and equipment are not movable.

3. Hearing Conservation Program. Workers who are exposed to hazardous noise in excess of the exposure limits shall be included in the hearing conservation program. This program provides for initial and annual audiometric testing. Workers on the Hearing Conservation Program must carry ear plugs, or ear muffs with them during duty hours and wear their hearing protection equipment whenever near a hazardous noise source in use and while in hazardous noise areas.

V. RESULTS AND DISCUSSION

A. Coal and Ash Dust

1. Bulk Samples. The free silica content of the bulk coal dust samples taken from the coal yard was 1.9%. The silica content of ash taken from the waste ash silo was 3.0%. Samples taken during the same time period by the base Bioenvironmental Engineer showed the free silica content as 1.5% for coal dust, and 7.8% for waste ash. Averaging these results indicates the coal was 1.7% silica, the ash was 5.4% silica and dust combined from various coal and ash exposures would be approximately 3.6% silica.

a. Because workers have various duties throughout the plant that may expose them to a combination of coal and ash dust, applying either the coal, or the ash silica percentage is not appropriate unless the operation being sampled deals exclusively with coal or ash, i.e., coal yard transfer or SDS cyclone cleaning. For this reason, dust samples will be assumed to be 3.6% silica, unless either the only coal or ash rational applies. This conjecture agrees with an average 4% silica content found in general dust air samples taken during coal plant operations documented in a previous USAFOEHL Report (2).

b. Any of the three (coal, ash, or combined) silica content percentages can change when new coal is delivered during the course of the heating season. Future sampling and industrial hygiene practices should reflect this.

2. Area Sampling. Tables 2A and 2B depict the results of area sampling throughout the plant and during various routine operations. All area samples are total dust samples. The range of confidence limits give the statistical precision of the gravimetric analytical method at an arbitrarily chosen level. The most accepted level of confidence is when 95% of the values will fall within the given range. The coefficient of variation (CV) for gross dust determination is 0.05 mg/m³(3), and is used to calculate the confidence levels. Area samplers were run half-shift, approximately 5 hours.

a. We were interested in establishing background dust levels, while the plant was running strictly on natural gas, Table 2A. However, even though no coal was being moved or burned, nor ash transferred, residual coal and ash dust would still be encountered as workers performed routine maintenance, cleaning and inspections. Prior to coal transfer operations, area coal dust levels were about 0.08 ± 0.07 mg/m³. If 50% of a total dust sample was to be considered respirable dust, and applying this hypothesis to the worse case sample of the transfer house, sample 51, a relevant statement can be made about the overall dust concentration; the upper 95% confidence limit of this result was still only about one twenty-fifth of the less-than 5% silica TLV. This indicates no problems, but could drastically shift if the silica content of the coal changes to greater than 5%. Even though these results do not reflect exposures, they are indicative of the house cleaning problems caused by the coal transfer system, i.e., area samples 51, 53, and 54. For a brand new plant, dust levels this high are excessive and forewarns of worsening conditions as the plant ages. The control room, as expected because of the computers, was relatively dust free. A dust level of 0.02 mg/m³ is approximately 0.12 million particles per cubic foot of air.

TABLE 2A
AREA COAL DUST CONCENTRATIONS--PRIOR TO COAL MOVING

SAMPLE	AREA/OPERATION	CONC (mg/m³)
50	Coal unloading bunker	0.03
51	Transfer house	0.16
52	Waste ash silo	<0.01
53	Conveyor 4, tension weight	0.15
54	Scale floor, on 2 HWGT scale	0.09
56	Control room, (13.5 hour)	0.02
	average (n=6)	0.08
	standard deviation (n=5)	0.07
	average, upper 95% confidence limit	0.18
	worse case, sample 51, upper 95% confidence limit	0.24

b. Table 2B shows the area dust concentrations when coal was being moved from the coal pile, onto the conveyors, and into the storage hoppers which fed the boilers. Using the 50% respirable dust fraction rule of thumb, three out of six areas exceeded the >5% silica TLV. The transfer house had a sampling filter too overloaded with dust to be analyzed. Even the waste ash silo area, which is far removed from the coal transferring system, was influenced by the operation. This area's dust concentration showed an order of magnitude increase. Calculating averages and computing confidence limits are futile with concentrations as grossly removed from the TLV as these. Again, these levels are not exposures, but indicators of problem areas and pointers to potential exposures. They mark the significant difference between coal burning and natural gas use in this plant.

TABLE 2B
AREA COAL DUST CONCENTRATIONS--DURING COAL MOVING

SAMPLE	AREA/OPERATION	CONC (mg/m^3)
39	Coal unloading bunker	3.10
40	Transfer house	overloaded filters
41	Waste ash silo	0.43
42	Conveyor 4, tension weight	3.08
43	Scale floor, on 2 HWGT scale	1.43
16	Catwalk, outside control room -during boiler fire-up & soot blowing	0.34

3. Breathing Zone Samples. Samples taken in the breathing zone of the workers are the best indication of the actual occupational exposure. This is true in most cases, except those in which the worker wears respiratory protection. Respirator use is noted with an asterisk next to the sample number. Tables 3A, 3B and 4 show the results of the dust sample analysis taken in the breathing zone of the workers. In Table 4, the "T" notation labels total dust samples and the "R" notes respirable dust samples. Most of the personal breathing zone samples ran half shift, approximately 5 hours. Shorter sampling times were used if a specific operation was short in duration, or if the filter became visibly overloaded with coal dust or ash. The "G" notation following the sample number indicates that the sample was taken during gas burning. All other samples were collected during coal firing.

a. Table 3A shows the total dust breathing zone concentrations. Considering that sampling during general plant work will pick up coal, ash, soot, quicklime and other debris dusts, the 1.26 mg/m^3 average is a good indication of gross exposure; about one eighth of the nuisance dust TLV. Even the worse case, sample 32, shows the exposures to be one forth the TLV. Side-by-side, total and respirable dust sampling done on Mr Atkinson, samples 23 (Table 3B) and 24, is an illustrative example of the 50% total/respirable dust rule of thumb.

TABLE 3A
TOTAL COAL AND ASH DUST, BREATHING ZONE CONCENTRATIONS

SAMPLE	EMPLOYEE	SHIFT	OPERATION/SOURCE	CONC (mg/m³)
24	ATKINSON	Day	SDS Maint/Floor operations	0.60
25	ATKINSON	Day	SDS Maint/Floor operations	0.18
27	STRICKLAND	Swing	General Maint/Floor operations	1.61
29	KASTEN	Swing	General Maint/Floor operations	2.00
32	OVERSTREET	Night	Floor operations	2.51
34	MARCHIANO	Night	Floor operations	1.28
35	BLACHFORD	Day	Floor operations	0.84
37	CROSS	Day	Floor operations	1.08
			average (n=8)	1.26
			standard deviation (n=7)	0.76
			worse case, sample 32 upper 95% confidence limit	2.59
			sample 32, lower 95% confidence limit	2.42

b. Table 3B has more definitive exposure information with its respirable dust sample results. The gas burning exposures are one-half to one-third the coal firing exposures. Taking into account that the dust silica

TABLE 3B
RESPIRABLE COAL AND ASH DUST, BREATHING ZONE CONCENTRATIONS

SAMPLE	EMPLOYEE	SHIFT	OPERATION	CONC (mg/m³)
10	CROSS	Day	Floor Maint/General operations	0.09 (G)
11	BLACHFORD	Day	Floor Maint/General operations	0.13 (G)
13	BLACHFORD	Day	SDS Maint/Floor operations	0.07 (G)
23	ATKINSON	Day	SDS Maint/Floor operations	0.35
26	BLACHFORD	Day	Floor Maint/General operations	0.11
28	STRICKLAND	Swing	General Maint/Floor operator	0.33
30	KASTEN	Swing	General Maint/Floor operator	0.23
31	MARCHIANO	Night	Floor operations	0.29
33	OVERSTREET	Night	Floor operations	0.39
36	BLACHFORD	Day	Floor operations	0.34
38	CROSS	Day	Floor operations	0.38
55	SPRIGG	Day	SDS Maint inside inspection-top	overloaded
			average (n=11)	0.25
			standard deviation (n=10)	0.12
			log-normal average (n=11)	0.21
			worse case, sample 38 upper 95% confidence limit	0.53
			sample 38 lower 95% confidence limit	0.24
			possible >5% silica, sample 23 upper 95% confidence limit	0.41
			sample 23 lower 95% confidence limit	0.28

content is an average 3.6%, applying the <5% coal TLV of 2 mg/m³ seems appropriate. This being the case, the average plant exposure is less than the action level (one-half the TLV) of 1 mg/m³. Even taking into account that the exposures could be log-normally distributed, the average exposure as defined by the geometric mean is still slightly less than the arithmetic mean. However, when considering the distribution outliers and the fact that during these exposures the dust concentrations could constitute a majority of 5.6% silica ash, workers could be overexposed. An example would be during SDS maintenance, sample 23, where the exposure was at least twice the >5% silica TLV of 0.1 mg/m³. This consideration points out the need to evaluate some exposures during certain, individual operations.

c. Table 4 shows the sampling results during special operations. Taking the average of these exposures is meaningless because their purpose is to show the individual exposures as they relate to the specific duties. Averaging a number of samples taken during the same, or similar operations is very meaningful; but our survey afforded us neither the time, nor opportunity for replicate sampling.

TABLE 4
SPECIAL OPERATIONS, DUST BREATHING ZONE SAMPLES

SAMPLE	EMPLOYEE	OPERATION/SOURCE	TIME (min)	CONC (mg/m³)
12	GUILLIANS	Day shift control room operator	165	<0.01 (R)
		SDS MAINTENANCE (ASH)		
15*	SPRIGG	cyclone inspection-inside top	11	5.88 (T)
18*	BLACHFORD	cyclone cleaning-inside bottom	72	overloaded
19*	BLACHFORD	cyclone cleaning-floor clean-up	58	4.60 (R)
21*	SPRIGG	SDS cyclone top inspection	14	4.46 (T)
22*	SPRIGG	SDS cyclone top inspection	26	9.10 (R)
44	COALYARD	Front-end loader, moving coal	143	0.85 (R)
		Sample 44, upper 95% confidence limit		0.93
		CHEMICAL SOLUTION MIXING		
45*	LAB WORKER	Batch mixing with water	6	<0.01 (R)
46*	LAB WORKER	Batch mixing with water	6	<0.01 (T)
		SLACKING LIME FOR SDS		
47	MURDOCK	Gen Maint/mixing CaO with water	325	0.11 (R)
48	MURDOCK	Gen Maint/mixing CaO with water	325	0.16 (T)
49	MILLNER	Batch mixing CaO with water	137	0.20 (R)
		Sample 48, upper 95% confidence limit		0.24

* Respirators used
T Total dust sample
R Respirable dust samples
G Gas burning operations

(1) Control Room. Sample 12. As expected, the control room was below the detection limits of the analytical procedure (<0.01 mg/m^3) and had little influence on the total dust exposure, except as a relief when workers took breaks in this area from floor duties.

(2) Desulfurization System (SDS). Samples 15, 18, 19, 21, and 22. The maintenance activities required by the desulfurization system, especially inspecting and cleaning the spray dry absorber/cyclone are by far the highest dust exposures measured. These concentrations are ninety times greater than the >5% silica respirable dust TLV of 0.1 mg/m^3. Fortunately, respiratory protection and time weighting the short exposure periods decreased the total exposure to acceptable levels.

(3) Coal Yard. Sample 44. Work in the coal yard did not expose the front-end loader to coal concentrations greater than the <5% silica TLV. Even if the silica concentration would change to >5%, the time weighting factor would protect the worker; unless his other front-end loading duties around the base further exposed him to silica, i.e., sand and gravel work. We had no opportunity to sample other coal yard work (articulated hoe operator or railcar receiver); hence, no results.

(4) Water Chemicals. Samples 45 and 46. Batch mixing chemical solutions for descaling, water treatment and pH adjustment poised no inhalation exposure problems. Mixing duration was short, the area was clearly marked with appropriate warning signs "DANGER CAUSTIC MIXING - WEAR GLOVES & EYE PROTECTION," and caution was used by the employee during the process.

(5) Slaking. Samples 47 to 49. Slaking quicklime into limemilk for the SDS system is a rotated, on-off job with a calcium oxide exposure best reflected by sample 48. The upper confidence limit of 0.24 mg/m^3 is still about one tenth the TLV. These samples showed there was not an inhalation problem from exposure to calcium oxide for the slaking process.

d. It's interesting to compare Tables 2, 3 and 4 and notice that the results seem to support that in most cases, the workers can avoid the high dust load areas (transfer tower during coal moving), unless a required duty forces them to be present (SDS cyclone cleaning).

B. Fugitive Gasses. We did direct reading tube monitoring for the fugitive gasses NO_x, SO_x, H_2S, and CO that may have escaped during any part of the heat generating process. All the readings were less than the detection limits of the tubes; indicating no fugitive gas problems.

C. Noise. Considered cumulative, the noise results are representative of what workers encounter during their work shift. The busy day shift was observed to be more noisy than the swing shift, which was more noisy than the slow night shift. Averaging the exposure times and sound level readings is valid because all the floor operators work all three shifts, rotating within a two weeks period. All the noise measurements are reported without regard to the use of personal protective equipment. Actual exposures would be reduced by earplugs/muffs.

1. Noise Dosimetry. The noise dosimetry results for every shift during the three survey days are shown in Table 5. Each result averages the noise exposure of a half shift (5-6 hours). Nine workers were monitored. The total dosimetry time was 75.23 hours, with an average noise exposure of 83.8 dBA. The average exposure is very close to the permissible noise exposure limit of 84 dBA. Even though the plant was noticeably less noisy during gas burning, the dosimetry results during either gas or coal combustion were about the same. An asterisk denotes gas burning shifts.

TABLE 5
PERSONNEL NOISE EXPOSURE - NOISE DOSIMETRY

SHIFT	AVG dBA	WORKER
D*	84.6	Blachford
D*	85.1	Cross
N*	79.9	Marchiano
N*	79.5	Voelker
D	83.9	Blachford
D	78.8	Atkinson
S	84.4	Katsen
S	85.4	Strickland
D	89.0	Blachford
D	85.9	Cross
S	81.9	Murdock
S	87.6	Millner

Total time monitored: 75.23 Hours
Average exposure: 33.83 dBA
* Denotes gas burning shifts

2. Sound Level Meter Survey. A General Radio sound level meter, model 1982, was used to measure noise levels of certain noise producing equipment and in various areas of the power plant. The hazardous noise generating sources, their locations, and their noise levels are tabulated in Table 6. All of these noise readings were taken during coal burning.

a. Basement. Most of the equipment in the basement of the plant operates intermittently, but routinely, and produced hazardous noise. The general noise level throughout the basement level usually exceeded 84 dBA.

b. First Floor. The first floor has some noisy equipment, the most obvious being the constantly operated stoker/boiler. At most of the first floor locations, noise levels were below hazardous noise levels, except near operating equipment. The control room had noise levels well below the noise limits for voice communication.

c. Second Floor. This floor was comprised mostly of catwalks and had less operating equipment and more passive equipment than the first floor, i.e., flue gas ducting. Its general noise levels were below the hazardous noise level in most areas. Noise from below did filter up and there was a noise hazardous electrical equipment room.

TABLE 6
NOISE LEVELS - EQUIPMENT AND LOCATIONS

SOURCE AND LOCATION		dBA
Basement Area:	Over Fire Air Fan	95.6
	Instrument Air	96.8
	Air Compressor	103.0
	Clinker Grinder	97.0
	Coal Ash Transfer	96.3
	High Pressure Make-up Water Pump	92.3
First Floor:	Central Vacuum Cleaner	82.0
	Around Stoker(when on)	88.3
	BTU 300 Dryer	92.0
	FGD-Ash Removal Vacuum Pump	97.8
	FGD-Recycle Bin Aeration Blower	89.0
	Generator Room (inside, during use)	106.1
	Generator Room (outside, during use)	81.6
Second Floor:	Electrical Equipment Room	87.2
Third Floor:	Rotary Ash Feeder	91.7
	Induced Draft Fan	87.0
	Main Ash Vacuum Pump	98.7
	Ash Dustless Unloader	98.3
Fifth Floor:	Coal Bunker (during coal transfer)	98.0
	Near Elevator " " "	85.8
	Most locations " " "	91.0

d. Third Floor And Up. Not really floors, but layers of catwalks that connected various sections of the plant together. These floors contained no noise sources and noise levels were well below 84 dBA throughout; except in the waste ash handling area (3rd floor) and the top of the coal conveying system (5th floor).

e. All noise readings taken in the SDS section were below 84 dBA.

D. Temperature. During the survey, heat and cold stresses were not problems inside the heating plant. Inside temperatures ranged from 65° to 75°F. The outside temperature ranged from 25° to 35°F. The coal yard operator did not complain of cold, and was protected from the elements by the front-end loader cab. We did not evaluate the railcar unloader who was unprotected from cold and high speed winds; nor could we evaluate heat stress that may be a problem during summer operations.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. Gas Burning. Observations and results indicated there were minimal exposures to occupational hazards during gas burning. All results prior to coal operations were below exposure limits, except for noise and when duties during gas burning were actually connected with coal combustion. However, this plant is primarily for coal combustion and the industrial hygiene emphasis should focus on coal related hazards.

B. Coal Delivery. Coal delivery can be a coal dust inhalation hazard and a cold stress problem for the railcar unloader/articulated hoe operator. These hazards must be evaluated by the local BEE. The front-loader operator was not overexposed to a dust, or cold hazard while working in the coal yard.

Recommendation: Request railcar unloading be evaluated by base BEE during the next coal delivery.

C. Coal Transfer. The most obvious occupational inhalation hazard was during coal transfer. Fortunately workers can somewhat avoid this problem by staying away from the coal transfer conveyors and tower. A better solution would be to fix the coal dust recovery system and make it operate as designed. A review of the system and its initial ventilation survey should be done by a competent ventilation engineer. If the reviewing engineer does not find the problem and render a solution, another complete ventilation survey must be performed. We suspect the problem may be with the way the ducting into the centrifugal fan is plumbed, Figure 16.

Figure 16: Dust Recovery System, Fan With Entrance Duct

Severe necking down of the fan's entrance duct creates excessive pressure and airflow disturbances, and can render a fan ineffective. This type of ducting was noticed on all the fans that serviced the dust recovery system. In the event that workers must enter these areas during coal transfer, a supplied air respirator must be worn. Lesser respiratory protection, such as a canister half-face, or a disposable respirator (dust mask), can be used during entrances when coal is not being transferred.

Recommendation: Have the coal plant builders evaluate and fix the dust recovery system on the coal conveyors.

Recommendation: Until the dust problem is mitigated; procure and wear the proper type of respirator when entering the coal transfer facilities. Pass all respirator ordering requests through the base BEE for concurrence.

C. Coal Grinding. Coal dust and noise exposure monitoring must be done once sample grinding commences. Enclosing the operation has been suggested to control the excessive coal dust generated, but an enclosure would just aggravate the noise and dust hazard. It would be better to keep the coal grinding operation outdoors, or in the coal bunker and connect it to the bunker's dust recovery system. If grinding is moved into the plant, a local exhaust ventilation system must be installed to control the dust.

Recommendation: Do not grind coal samples without adequate dust controls; either move the operation outdoors, or control the dust generation with adequate ventilation.

D. Ash Dust. Since ash has a higher silica content than coal, it should be treated as the greater industrial hygiene hazard. This is especially true due to its abrasive and caustic physical properties which can be severe mucus membrane irritants.

1. SDS Spray Dry Absorber/Cyclone Inspection. Inspecting and cleaning the SDS vessel exposes workers to the highest concentrations of total and respirable ash measured. This is not a dust exposure that can be avoided like coal transfer. In-vessel inspection must continue to be done with a full facepiece approved dust respirator. In-vessel cleaning should only be done with a full facepiece supplied air respirator. Other engineering controls should be instituted to control the dust during vessel cleaning. A wall fan capable of exhausting 3000-4000 fpm should be installed in the immediate area of the vessel manhole, where the cake (waste ash) is shoveled out. An efficient vacuum system is needed for house cleaning in the SDS building, even better would be a vacuum powerful enough to clean and carry the ash cake out of the vessel, possibly one that is connected to the pneumatic ash removal system.

Recommendation: Institute engineering controls to control the airborne ash generation during vessel clean out.

Recommendation: Use the proper type of respirator when inspecting and cleaning the SDS vessel.

2. Shot-gunning the cake that builds up in the SDS vessel, while not an occupational health hazard with set standards, should be abandoned for a more effective method. Possibly better control and finer tuning of the absorbing process would reduce the amount of cake build-up. An expert in that field should be consulted.

Recommendation: Seek an alternate method of preventing or loosening the SDS cake.

3. Bag house dust exposure, while not monitored during this survey will constitute a confined space dust exposure that will probably require a supplied air respirator. The local BEE must be involved with monitoring any maintenance inside the bag houses.
Recommendation: Involve the base BEE in the next bag house entrance.

4. The current dustless loader that handles waste ashes needs to be fine-tuned or redesigned. Not only does inadequately prepared ashes cause an in-house exposure, but the computer rooms fresh air intake up-takes fugitive dust. Also, the disposal route, from the truck loading area to the landfill is burdened by escaping dust. A possible temporary solution is to spray water at the incompletely mixed ash stream as it is being dumped into the truck.

Recommendation: Have the coal plant contractors evaluate, adjust and fix the dustless loader.

Recommendation: In the interim, hose down the ash as it's being transferred to the dump truck.

E. Chemical Hazards. There were no significant airborne exposures during the survey. The continued wearing of face-shield or goggles, gloves, apron or coveralls, and dust mask is recommended and encouraged.

1. Slaking quicklime (calcium oxide) into limemilk (calcium hydroxide) is more of a contact hazard than an inhalation hazard. The currently issued foul weather gear is not adequate protection for the worker. A caustic chemical resistant (PVC or like) full length apron with shoulder length gloves is more appropriate and should provide protection and comfort. If needed, USAFOEHL or the local BEE can provide various designs and sources of protective equipment.

Recommendation: Procure and use appropriate protective clothing during slaking.

2. Entering and cleaning the limemilk holding tanks will require more personal protection than slaking. A full body coverall with hood will be needed to control the contact hazard, and the proper level of respiratory protection as determined by the BEE will also be required.

Recommendation: Involve the base BEE during the next limemilk tank entrance and cleaning.

3. The chemical hazards posed by the water treatment chemicals, laboratory test chemicals, and routine oils and maintenance products are minimum and adequately controlled with current practices.

4. Personal hygiene was observed to be adequate, but it is prudent to note that soot contains known contact carcinogens. All workers should be informed of this and encouraged to wear protective coveralls and to wash regularly, especially young workers who may be more likely to disregard the consequences of a dirty job. The base Environmental Health Office can provide you with more information on this hazard.

Recommendation: Encourage workers to maintain high standards of personal hygiene, and make this and other hazard information a regular part of safety and newcomers briefings.

5. Fugitive emissions (other than dust) were not an occupational exposure problem at the time of this survey.

F. Noise.

1. The whole plant, with the exceptions of the control room, break-room, and the SDS building should be considered as a hazardous noise area. Most certainly the basement and the fifth floor of the power plant are hazardous noise areas. The various equipments listed in Table 5 produce hazardous noise. Hazardous noise signs need to be posted throughout the power plant, or at the entrances to the plant. Noise caution labels should be placed on various hazardous noise generating equipment as described in AFR 161-35. The use of barriers and dampers to reduce, isolate and control those noise sources above 90 dBA should be considered. All floor and maintenance workers are routinely exposed to hazardous noise; therefore, they must be enrolled in the base Hearing Conservation Program, and wear hearing protection when inside the plant's noise hazardous areas and when near hazardous noise producing equipment.

Recommendation: Post the plant as a hazardous noise area. As a minimum, post only the basement and the 5th floor areas of the plant, and label as noise hazardous the equipment cited in Table 5.

Recommendation: Enroll all employees in the Hearing Conservation Program and re-evaluate the noise exposure the following year. Evaluate the hearing protection program annually and remove from the program those employees who consistently show they are exposed to sound pressure-levels less than the noise exposure limits.

G. Cold/Heat Stress. There are no heat stress problems during winter operations. Heat stress evaluations during steam pit inspection and other hot weather maintenance activities should be conducted by the local BEE. The coal yard railcar unloader is exposed to extremely cold conditions. Relief may be possible by taking numerous warm-up breaks in the plant. Consider providing an enclosed booth, or at least a wind screen for the articulated hoe operator.

Recommendation: Involve the base BEE during summer maintenance jobs so heat stress can be evaluated.

H. Occupational Health. Physical exams should be considered for the plant population. In addition to audiograms for noise exposure, pulmonary function tests should be done on all respirator users and on all workers who routinely work with coal and ash dust. Additionally, personnel must be fit tested for respirator use. Contact the base Environmental Health Office for these services.

Recommendation: Contact the base Environmental Health Office for the appropriate physical exams.

REFERENCES

1. American Conference of Governmental Industrial Hygienist (ACGIH), Threshold Limit Values and Biological Exposure Indices for 1987-1988, ISBN 0-936712-69-4, 1986

2. Project No. HAF-610, USAFOEHL Techical Report 78-58, Brooks AFB, TX 78235, October 1978

3. NIOSH, Occupational Exposure Sampling Strategy Manual, US DHEW Pub. No. 77-173, US Government Printing Office, Wash DC, 20402, January 1977

4. Clayton D. C., et al., Patty's Industrial Hygiene and Toxicology, 3rd Ed., Vol IIC, John Wiley and Sons, 1982

Distribution List

	No. of Copies
HQ AFSC/SGPB Andrews AFB DC 20334-5001	9
HQ USAF/SGPA Bolling AFB DC 20332-6188	1
USAF Regional Medical Center Wiesbaden/SGB APO New York 09220-5300	1
OL AD, USAFOEHL APO San Francisco 96274-5000	1
USAFSAM/TSK/EDH Brooks AFB TX 78235-5301	1 ea
Defense Technical Information Center (DTIC) Cameron Station Alexandria VA 22314	2
HQ USAFE/SGPA APO New York 09012-5001	1
HQ PACAF/SGPA APO San Francisco 96853-5001	1
HQ AAC/SGPB Elmendorf AFB AK 99506-5300	1
HQ AFLC/SGB Wright-Patterson AFB OH 45433-5001	1
HQ MAC/SGPB Scott AFB IL 62221-5001	1
HQ SAC/SGPB Offutt AFB NE 68113-5001	4
HQ ANGSC/SG Andrews AFB DC 20331-6008	1
HQ AFRes/SGPB Robins AFB GA 31098-6001	1
USAF Academy Hospital/SGPB Air Force Academy CO 80840-5470	1
USAF Regional Hospital Maxwell/SGPB Maxwell AFB AL 36112-5304	1

Distribution List (Cont'd)

HQ TAC/SGPB Langley AFB VA 23665-5001	1
HQ SPACECOM/SGPB Peterson AFB CO 80914-5001	1
HQ ATC/SGPB Randolph AFB TX 78150-5001	1
HQ AFESC/DEM Tyndall AFB FL 32403-5000	1
SD/SGX P.O. Box 92960 Worldway Postal Center Los Angeles CA 90009-2960	1
USAF Hospital/SGPB Malmstrom AFB MT 59402-5300	3
USAF Hospital/SGPB F. E. Warren AFB WY 82005-5300	1
USAF Hospital/SGPB Fairchild AFB WA 99011-5300	1

* GOVERNMENT PRINTING OFFICE: 1987 - 561048 / 60032

END
DATE
FILMED
5-88
DTIC