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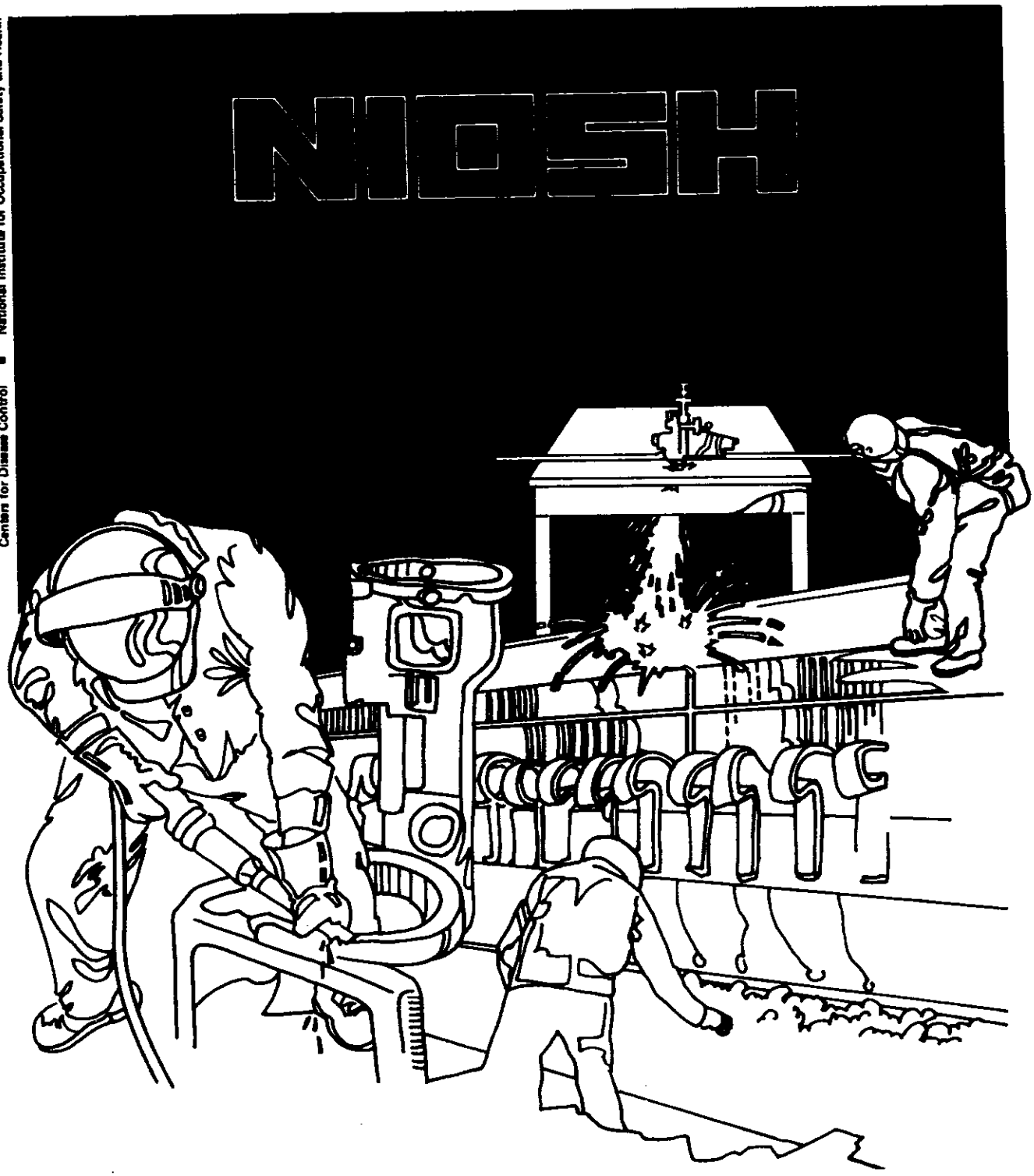

Health Hazard Evaluation Report

MHETA 87-295-1867
HIGH POWER ENERGY
DRENNEN, WEST VIRGINIA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial nygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

MHETA 87-295-1867
HIGH POWER ENERGY
DRENNEN, WV
DECEMBER, 1987

NIOSH INVESTIGATOR
Rick Ferguson, IH

I. SUMMARY

In May 1987, the National Institute for Occupational Safety and Health (NIOSH), Division of Respiratory Disease Studies, received a request from the United Mine Workers of America, Local 8531, Cowen, West Virginia, to evaluate the potential for heat stress among the coal and rock truck drivers at High Power Energy's No. 901 strip mine located at Drennen, West Virginia. NIOSH conducted heat stress surveys on August 4, 5, and 13, 1987.

Heat stress measurements (Wet Bulb Globe Temperature-WBGT) were made in thirteen of the sixteen rock and coal trucks during the hottest portion of the day. Since there are no current Mine Safety and Health Administration (MSHA) regulations specifically established for heat stress conditions, the revised NIOSH criteria document,("Occupational Exposure to Hot Environments"), April 1986 was used to evaluate the potential heat stress for each individual driver. It was found that the NIOSH Recommended Exposure Limit (REL) was exceeded in all the coal and rock trucks monitored.

Data from this hazard evaluation indicate that during hot, humid weather conditions, truck driver's at the No.901 strip mine are exposed to potentially hazardous heat loads. It is recommended that a comprehensive program of heat stress management be instituted or that truck cabs be air conditioned.

KEYWORDS: SIC 1211 bituminous coal, heavy equipment, heat stress.

II. INTRODUCTION

Section 501(a)(11) of the Federal Mine Safety and Health Act of 1977, Public Law 91-173, as amended by Public Law 95-164, authorizes the Secretary of Health and Human Services through the National Institute for Occupational Safety and Health to determine, upon the written request by any authorized representative of miners, whether any physical agent or equipment found or used in a coal mine has potentially hazardous effects. NIOSH received such a request from the United Mine Workers of America, Local 8531, Cowen, West Virginia, to evaluate heat exposures experienced by truck drivers at High Power Energy's No. 901 strip mine in Drennen, West Virginia.

III. BACKGROUND

At this mine, the overburden is first loosened by blasting. Front end loaders are then used to deposit the overburden into 85 ton Catepillar and Komatsu rock trucks for transport to a reclamation area. Once the overburden has been removed from the coal seam, the coal is then loosened by blasting. The front end loaders then load the raw coal into 85 ton Dart coal trucks. The coal trucks haul the raw coal to the raw coal scales and then travel to the raw coal dump point where it is transported to the preparation plant

Rock trucks run short hauls (approximately 9-11 minutes from loading to loading). The coal trucks may run long hauls (25 minutes) or short hauls (15 minutes) depending on the needs of the company on a particular day. A long haul is characterized as follows: load with clean coal at the preparation plant, travel to the scales to be weighed, travel to the clean coal dump point, unload, travel to the raw coal pit, load, travel to the raw coal scales, and travel to the raw coal dump point, and then back to the clean coal loading point. A short haul is characterized by loading at the raw coal pit, travel to the raw coal scales for weighing, then to the raw coal dump point and back to the raw coal pit.

At the No. 901 strip mine, there are six coal trucks and ten rock trucks, none of which are air-conditioned. The work shift runs from 7 a.m. to 4 p.m. with a half-hour break for lunch. Lunch is usually eaten between 12-12:30 in the trucks, or on hot summer days, in the bucket of a front end loader. With the exception of lunch, the work is continuous.

IV. METHODS AND MATERIALS

Total heat stress is considered to be the sum of heat generated in the body (metabolic heat) plus the heat gained from the environment

(environmental heat). In order to evaluate the total heat stress, the following methods were utilized: (1) A portable Reuter Stokes* heat stress monitor was used to determine the Wet Bulb Globe Temperature (WBGT) inside each truck cab and (2) an estimation was made for each driver's metabolic heat load. In addition, a stationary WBGT tree was set up outdoors across from the raw coal dump point to monitor the outdoor WBGT. This WBGT tree consisted of a tripod with clamps set up for holding a black globe with a thermometer inside it, a dry bulb thermometer and a wicked thermometer for the natural wet bulb measurement. The outdoor WBGT tree was primarily utilized to determine at what time during the shift, conditions were the hottest for monitoring the truck cabs for environmental factors of heat stress. According to the NIOSH revised criteria document for Occupational Exposure to Hot Environments,[1] environmental measurements are to be made during the hottest portion of the shift. Since the "hottest portion" is undefined, the truck measurements were initiated when the outdoor ambient and natural wet bulb temperatures were 88° F and 76° F respectively.

Since the WBGT tree was set up near the raw coal dump, the individual who monitored the coal trucks, also monitored the WBGT tree. During the survey, the heat stress monitor was hand held and positioned in the center of the truck cab at about chest height. As each truck was monitored, a minimum of six WBGT measurements were taken each hour to get an hourly environmental time weighted average (TWA).

To estimate the average metabolic heat load for each driver's task, an estimate for this task was obtained by using Table V-3 in the NIOSH criteria document. In Table V-3, sitting is estimated at 0.3 Kilocalories/minute (Kcal/min), light work, both arms at 3.5 Kcal/min and basal metabolism at 1.0 Kcal/min. for a total heat expenditure of 4.8 Kcal/min. To get the total expenditure per hour, multiply by 60 minutes.

In an attempt to determine when there would be at least three days with temperatures in the ranges of 88° - 95° F for Drennen, WV, weekly, long-range forecasts were obtained from the National Weather Service in Charleston, WV.

v. EVALUATION CRITERIA

The revised NIOSH criteria document for Occupational Exposure to Hot Environments[1] was utilized to evaluate the heat stress potential for each truck driver. The combination of environmental and metabolic heat

*. Mention of company names on products does not constitute endorsement by the National Institute for Occupational Safety and Health.

load is used to determine whether a Recommended Exposure Limit (REL) is exceeded. The criteria document assumes the workers are acclimatized, fully clothed in summer weight clothing, physically fit, have good nutrition, and have adequate salt and water intake. Additionally, they should not have any pre-existing medical conditions which might impair the body's thermo-regulatory mechanisms. Alcohol use and certain therapeutic or over-the-counter medications can also impair the body's heat tolerance and may increase the risk for heat injury or illness.

The metabolic heat load for a standard truck driver weighing 70 Kg(154 pounds) can be estimated as follows:

Body Position - sitting;	0.3 kcal/min
Type of Work - both arms, light;	3.5 kcal/min
Basal Metabolism	1.0 kcal/min
Total =	4.8 kcal/min

Based on individual body weight, this estimated metabolic heat load can be adjusted for each driver as follows:

$$\text{Metabolic heat (kcal/hour)} = 4.8 \left(\frac{\text{kcal}}{\text{min}}\right) \times \frac{\text{driver weight (lb)}}{154 \text{ (lb)}} \times \frac{60 \text{ (min)}}{1 \text{ (hour)}}$$

Figure 1, taken from the NIOSH criteria document, was used to determine if the REL for continuous work (60 min/hr) was exceeded. To determine REL, a vertical line is drawn from the metabolic heat load (kcal/hr) to the 60 min/hr curve. At that point a horizontal line is drawn over to the environmental heat-WBGT. If the environmental WBGT determined from the portable Reuter Stokes instrument is greater than the environmental heat-WBGT in Figure I, then there is a potentially hazardous heat stress exposure.

VI. RESULTS

Over the duration of this survey, a total of 94 heat stress measurements were obtained in thirteen trucks in order to determine the WBGT-TWA for each truck. Another 35 measurements were taken outdoors using the WBGT tree. The WBGT TWA ranged from 82.3° F to 88.4° F. The estimated metabolic heat for the thirteen driver's ranged from 271 to 504 Kcal/hr.. The recommended exposure limit for these driver's ranged from 77-83°F. In all of the trucks monitored, it was determined using Figure I, that a potentially hazardous heat stress condition existed. This data is summarized in Table I.

VII. DISCUSSION/CONCLUSION

WBGT measurements were taken during late morning and afternoon hours on days which were expected to have conditions of high temperature and humidity. The NIOSH exposure limit for WBGT was exceeded in all coal and rock trucks monitored, indicating that workers were exposed to conditions which have the potential to result in heat stress. Under such conditions, precautions should be taken to protect workers from the effects of heat stress. The hot environment can be eliminated by using engineering controls, such as air conditioning, or the risk of significant health effects can be limited by adopting administrative practices. Either approach is acceptable.

VIII. RECOMMENDATIONS

The following are recommendations for controlling conditions of potential heat stress.

I) Engineering Controls:

Provide air conditioning in the trucks.

II) Administrative Practices:

A) A pre-placement and /or periodic medical examination should be provided to drivers to determine their capacity to tolerate heat. This examination should include:

1) medical history (cardiovascular system, liver, kidney, respiratory system and any pre-existing heat illness);
2) physical exam (giving attention to the items in the medical history);
3) an assessment of the use of drugs; therapeutic, over the counter, or social;
4) an assessment of obesity, defined as exceeding 25% of normal weight for males based on age and build.

B) Purchase a heat stress monitor and conduct measurements for heat stress conditions over the shift in order to determine when to initiate work-rest periods.

C) Provide a rest period (of 15 minutes) each hour for the driver to get out of the truck and move around in a cool environment.

D) Start the work shift earlier in order to reduce heat exposure during the day.

E) Provide adequate amounts of cool water (50-59° F) and encourage the workers to drink liquids frequently.

F) Initiate a buddy system where workers are responsible for observing fellow workers for early signs of heat stress.

G) Provide training to foremen and workers to recognize early warning signs of heat illness and how to administer first aid procedures.

IX. REFERENCES

1. National Institute for Occupational Safety and Health. Criteria for a recommended standard: occupational exposure to hot environments, revised criteria. Cincinnati, Ohio: National Institute for Occupational Safety and Health, April 1986. (DHHS publication No. (NIOSH) 86-113).

X. AUTHORSHIP AND ACKNOWLEDGMENTS

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45526. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. UMWA Local 8531
2. High Power Energy
3. MSHA, District Office
4. MSHA, Headquarters

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

HIGH POWER ENERGY

No. 901 Strip Mine
MHETA 87-295
Drennen, WV

TABLE I

Truck	Date	TIME	WBGT TWA(°F)	WBGT REL(°F)	Estimated Metabolic Heat(Kcal/hr)	Outdoor Temperature °F
K-8	8/4/87	11:25a-12:25p	82.3	77	504	90
K-9	8/4/87	12:50p-1:50p	83.9	80	420	91
C-1	8/4/87	1:55p-2:55p	85.3	79	412	91
C-3	8/4/87	3:00p-4:00p	84.5	82.5	279	92
D-4	8/5/87	12:40p-1:40p	82.3	80	346	NT
D-4	8/4/87	11:00a-12:00p	88.4	81	328	90
D-2	8/4/87	12:40p-1:40p	87.0	80	346	91
D-5	8/4/87	1:45p-2:45p	85.3	79	420	91
D-1	8/4/87	2:50p-3:50p	87.5	83	271	92
D-6	8/5/87	12:45p-1:45p	80.5	80	346	NT
D-3	8/13/87	1:10p-2:10p	83.7	81	328	90
D-2	8/13/87	2:15p-3:13p	84.2	80	346	94
D-4	8/13/87	2:00p-3:00p	84.2	80	346	91

Note: K-Komatsu truck, C-Catepillar, D-Dart

WBGT TWA(°F) - a minimum of six readings were collected in each truck to get the environmental WBGT time-weighted average.

WBGT REL(°F) - An exposure level that is determined from figure 1 for each driver. This value should not be exceeded by the WBGT TWA.

NT- no outdoor temperature taken during this hour.