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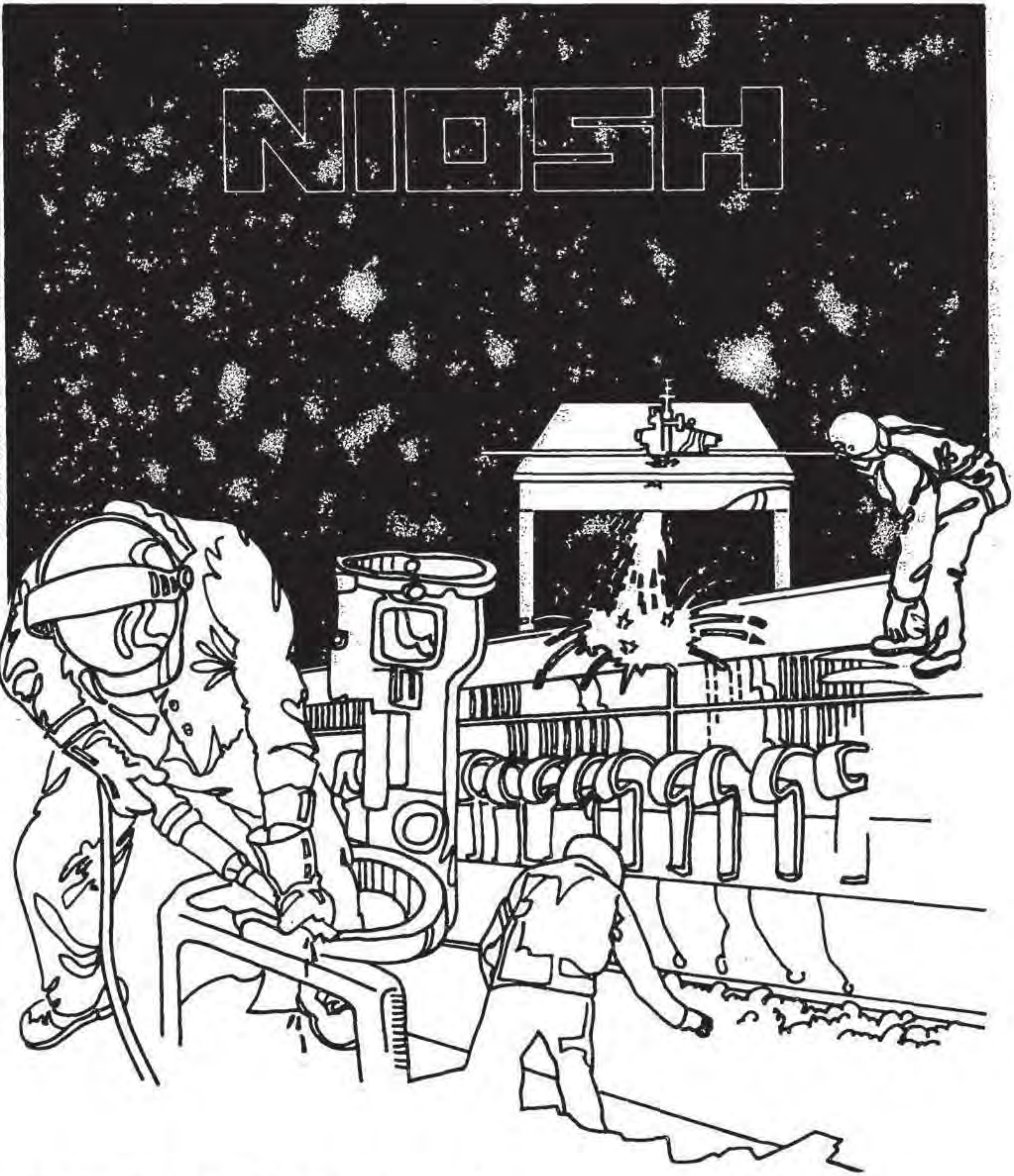

Health Hazard Evaluation Report

HETA 83-080-1307
CASE POWER & EQUIPMENT
BOLINGBROOK, ILLINOIS

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 hygiene 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.

HETA 83-080-1307
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CASE POWER & EQUIPMENT
BOLINGBROOK, ILLINOIS

NIOSH INVESTIGATOR:
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I. SUMMARY

On December 13, 1982 the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate employee exposures to carbon monoxide at a regional service center for J.I. Case Power and Equipment, Bolingbrook, Illinois. An employee at this facility had recently become acutely ill and was found to have an elevated carboxyhemoglobin level.

In January 1983, a NIOSH investigator conducted an initial survey during which general area air samples were collected for carbon monoxide, carbon dioxide, hydrocarbons and sulfur dioxide, and questionnaires were administered to five employees working in the service area of the facility. In March 1983, a follow-up survey was conducted during which additional area samples and personal breathing zone air samples for carbon monoxide were collected.

General area air samples collected during the initial survey showed a time weighted average (TWA) concentration of 49 parts per million (ppm) carbon monoxide (OSHA standard - 50 ppm, NIOSH recommended standard - 35 ppm); 27 ppm hydrocarbons (OSHA - 500 ppm, NIOSH - 75 ppm); 1340 ppm carbon dioxide (OSHA - 5000 ppm, NIOSH - 10,000 ppm); and no detectable concentrations of sulfur dioxide.

During the initial survey an overhead ventilation system for service garages was being installed and was completed approximately two weeks prior to the follow-up survey. General area and personal breathing zone air samples collected during the follow-up survey showed reduced levels of carbon monoxide as a result of the installation of the overhead ventilation system. General area samples collected showed TWA concentrations of 8.3 ppm and 7.8 ppm carbon monoxide. Personal breathing zone air samples collected showed TWA concentrations of 5.4 ppm and 3 ppm carbon monoxide.

On the basis of the data collected in this study, NIOSH has concluded that at the time of the initial survey a potential health hazard existed due to elevated carbon monoxide levels and inadequate ventilation in the service area of this facility. However, the situation has been alleviated with the installation of the overhead ventilation system.

KEYWORDS: SIC 7538 (Diesel engine repair, automotive) carbon monoxide intoxication, carbon monoxide, diesel exhaust, overhead ventilation systems for service garages.

II. INTRODUCTION

On December 13, 1982 the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Case Power and Equipment, Bolingbrook, Illinois, for a health hazard evaluation. The request stated that one employee was overcome with what was believed to be carbon monoxide intoxication, and others were complaining of nose irritation, chest pains, and headaches.

On January 21, 1983 a NIOSH investigator conducted an intial survey. This survey consisted of an opening conference during which background information of the facility was obtained, confidential employee questionnaires were administered, and a walk through inspection of the facility was conducted during which general area air samples were collected for carbon monoxide, carbon dioxide, hydrocarbons, and sulfur dioxide. In March 1983, an interim report was sent to the requestor which included the results of air sampling conducted during the initial survey and preliminary recommendations for reducing employee exposures. On March 18, 1983, a follow-up environmental survey was conducted during which additional general area air samples and personal breathing zone air samples for carbon monoxide were collected.

III. BACKGROUND

This facility is a regional service center for J. I. Case power equipment. The equipment being serviced varies from small garden tractor models to heavier equipment, such as, front end loaders. The plant operates a single day shift extending from 8:00 AM to 4:30 PM.

Equipment to be serviced is driven into the service area, with the engine running only when necessary during the time it is in the building. The building was just recently constructed and completed in August 1982. Two completely separate heating systems serve the main building, a conventional heating system serves the office space and a direct fired, forced air, gas furnace serves the service area of the building. Two exhaust ducts are located on the north end of the building, approximately two feet above floor level. Located in a separate building is a diesel powered steam cleaner.

Complaints of odors associated with headaches, fatigue, and dizziness began when the heating system to the service area was turned on with the arrival of colder weather. Employees (mechanics) working in the area complained of the odors and requested that the heating system be shut down. Other complanints were precipitated by the running of the heating system.

On the day of the carbon monoxide intoxication incident, the affected employee had spent approximately one hour steam cleaning equipment in an unventilated building. After returning to the service shop he fainted and was taken by ambulance to a local hospital. There he received medical treatment and blood tests revealed elevated carboxyhemoglobin levels which are indicative of carbon monoxide intoxication. Since the time of this incident the steam cleaning building has been ventilated.

The day of the initial survey an overhead ventilation system for service garages was being installed, with flexible hoses to fit over the exhaust pipe of the equipment, and with the emissions to be discharged above the roof of the building. Two weeks prior to the follow-up survey the system was completed and became operational.

IV. EVALUATION DESIGN AND METHODS

During the initial survey of January 1983, general area air samples were collected for carbon monoxide, carbon dioxide, hydrocarbons and sulfur dioxide. Samples were collected on direct reading detector tubes connected via tygon® tubing to battery powered sampling pumps operating at 20 cubic centimeters per minute. Other information relating to sample collection are contained in Table II. Additionally, confidential questionnaires were administered to mechanics working in the service garage area.

The follow-up environmental survey of March 1983 included general area air sampling and personal breathing zone air sampling for carbon monoxide. Samples were collected in the same manner as the previous survey. Other information relating to sample collection are contained in Table III.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor

(OSHA) occupational health standards. Often, the NIOSH recommendation and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based solely on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refer to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommmended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

A. Diesel fuel exhaust.[1]

Diesel exhaust is considered to be the uncontrolled emission from the tailpipe of a diesel-powered vehicles and consists of many recognized toxic agents in two phases. The gas phase contains primary products such as carbon monoxide (CO), sulfur oxides (SO_x), nitrogen oxides (NO_x), and aldehydes (e.g., formaldehyde, acrolein). These influence the production in the atmoshpere of secondary chemical products, such as the oxidants ozone (O_3), nitrogen dioxide (NO_2), and peroxyacetyl nitrate (PAN). The particulate phase contains small respirable carbonaceous particulates that can aggregate. These provide a surface on which a number of organic chemicals are adsorbed, most notably polycyclic aromatic hydrocarbons (e.g., benzo[a]pyrene).

Some of the components of diesel exhaust have been shown in laboratory tests with bacteria, animal cells, and tissues to be toxic, mutagenic, or carcinogenic. Moreover, many components are adsorbed on diesel exhaust particulates that are small enough to be inhaled and deposited deep within the lungs.

The effects of human exposure to whole diesel exhaust have not been conclusively demonstrated. Several environmental and physiological factors may bear on the potential threat of diesel exhaust to human health. Once emitted from the tailpipe, the exhaust is subject to environmental dispersion, transport, and chemical transformation--all capable of altering its components and concentrations in the ambient air at the point of human contact.

1. Carbon monoxide

Carbon monoxide is a colorless, odorless, tasteless gas usually occurring as a by product of incomplete combustion of carbonaceous material, with the major source of atmospheric CO being gasoline powered internal combustion engines. The current OSHA standard for carbon monoxide is 50 parts of carbon monoxide per million parts of air (ppm) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be reduced to 35 ppm averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling of 200 ppm.[2] The ACGIH has recommended a TLV of 50 ppm for a normal 8-hour workday and 40 hour workweek.[3]

Exposure to carbon monoxide decreases the ability of the blood to carry oxygen to the tissues. Inhalation of carbon monoxide may cause headache, nausea, dizziness, weakness, rapid breathing, unconsciousness, and death. High concentrations may be rapidly fatal without producing significant warning symptoms. Exposure to this gas may aggravate heart disease and artery disease and may cause chest pain in those with pre-existing heart disease.[2]

Carbon monoxide (CO) gas causes tissue hypoxia by preventing the blood from carrying sufficient oxygen. CO combines reversibly with the oxygen-carrying sites on the hemoglobin molecue with an affinity ranging from 210 to 240 times greater than that of oxygen; the carboxyhemoglobin (COHb) thus formed is unavailable to carry oxygen. In addition, carboxyhemoglobin interferes with the release of oxygen carried by unaltered hemoglobin. Concentrations as low as 50 ppm result in blood COHb levels up to 10% in an 8-hour day. This greatly increases the risk of angina pectoris and coronary infarctions by decreasing the oxygen supply in the blood and also in the myoglobin of the heart muscle. These effects are aggravated by heavy work, high ambient temperatures, and high altitudes. Smoking also increases the risk: cigarette smoke contains 4% CO, which results in 5.9% COHb if a pack a day is smoked. The blood of cigarette smokers contains 3 to 10% COHb, and nonexposed persons have an average level of 1%, probably as a result of normal heme metabolism.[2]

2. Carbon dioxide

The current OSHA standard for carbon dioxide is 5000 parts of carbon dioxide per million parts of air (ppm) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to 10,000 ppm averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling of 30,000 ppm averaged over a 10-minute period.[2] The ACGIH has recommended a TLV of 5000 ppm for a normal 8-hour workday and 40 hour workweek.[3]

Carbon dioxide is a colorless, odorless, non-combustible gas, soluble in water. It is a simple asphyxiant, concentrations of 10% (100,000 ppm) can produce unconciousness and death from oxygen deficiency. A concentration of 5% may produce shortness of breath and headache. Continuous exposure to 1.5% may cause changes in some physiological processes. The concentration of carbon dioxide in the blood affects the rate of breathing. Generally, adequate ventilation will provide sufficient protection for the worker.[4]

3. Hydrocarbons (based on n-octane)

The current OSHA standard for octane is 500 parts of octane per million parts of air (ppm) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be reduced to 75 ppm averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 385 ppm averaged over a 15-minute period.[2] The ACGIH has recommended a TLV of 300 ppm for a normal 8-hour workday and 40 hour workweek.[3]

4. Sulfur Dioxide

The current OSHA standard for sulfur dioxide is 5 parts of sulfur dioxide per million parts of air (ppm) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be reduced to 0.5 ppm as a time-weighted average for up to a 10-hour work shift, 40-hour workweek.[2] The ACGIH has recommended a TLV of 2 ppm for a normal 8-hour workday and 40 hour workweek.[3]

Sulfur dioxide is a colorless gas at ambient temperatures with a characteristic strong suffocating odor. Gaseous sulfur dioxide is particularly irritating to mucous membranes of the upper respiratory tract. Chronic effects include rhinitis, dryness of the throat, and cough.[4]

VI. RESULTS AND CONCLUSION

Results of the environmental samples collected during the initial survey showed detectable levels of carbon monoxide (49 ppm), carbon dioxide (1,340 ppm), and hydrocarbons (27 ppm). No detectable levels of sulfur dioxide were found, see table II for results. These samples were general area samples and do not represent personal exposures. Of the airborne contaminants detected only carbon monoxide was found to be above the NIOSH recommended limit of 35 ppm however, it did not exceed the OSHA permissible exposure limit of 50 ppm.

Results of environmental samples collected during the follow-up survey showed much lower detectable levels of carbon monoxide. General area samples collected showed TWA concentrations of 8.3 ppm and 7.8 ppm carbon monoxide, down considerably from 49 ppm during the initial survey. Personal samples collected near the breathing zone of two mechanics showed TWA concentrations of 5.4 ppm and 3 ppm carbon monoxide.

NIOSH has concluded that at the time of the initial survey a potential health hazard existed due to elevated carbon monoxide levels in the service area of this facility. Lack of adequate ventilation at the time of the first occurrence, coupled with a previous night's change from summer to winter climate control could have contributed to an air stagnation phenomenon that introduced new and/or unfamiliar odors to some of the workers.

At the time of the initial survey an overhead ventilation system for service garages with flexible hoses to fit over the exhaust pipes of the equipment was being installed and was to be operational within the next month or two following the survey. At the time of the follow-up environmental survey the system was completely operational. This system in itself has helped to significantly reduce carbon monoxide levels to below both the OSHA standard and the NIOSH recommended levels, as well as reducing any other contaminants of the diesel exhaust emissions.

VII. RECOMMENDATIONS

1. The overhead ventilation system that was installed should be carefully balanced for peak efficiency and routinely monitored to assure continued design performance.

2. Administrative procedures should be drawn up for the use of this system and should be strictly enforced.

3. All welding should be conducted behind flame resistant screens or in booths to protect other workers from flying sparks and to avoid flash burns to the eyes of persons in the area who are not wearing the proper eye protection.

4. Welding should not be conducted without adequate ventilation. Work should be arranged so that the moving air pulls the fume away from the workers breathing zone and not past the worker.

VIII. REFERENCES

1. Health Effects of Exposure to Diesel Exhaust NAS Committee Report, National Academy of Sciences, Washington D.C., 1981.

2. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, U.S. Dept. of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Publication No. 81-123, Cincinnati, Ohio, June 1977.

3. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1982, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1982.

4. Occupational Diseases - A Guide to Their Recognition, U.S. Dept. of Health, Education, and Welfare, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Publication No. 77-181, Cincinnati, Ohio, June 1977.

5. Code of Federal Regulations, Title 29, Parts 1900 - 1910, July 1, 1980.

IX. AUTHORSHIP

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X. DISTRIBUTION

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. 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 the NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Manager Case Power and Equipment
2. NIOSH, Region V
3. HETAB File
4. OSHA, Region V

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

TABLE I

ENVIRONMENTAL STANDARDS/CRITERIA[1]

Substance	NIOSH	OSHA	ACGIH-TLV
Carbon monoxide	35	50	50
Carbon dioxide	10,000	5000	5000
Hydrocarbons (n-octane)	75	500	300
Sulfur dioxide	0.5	5	2

1. All air concentrations are expressed as parts of vapor per million parts of air.
2. All air concentration are expressed as time-weighted average (TWA) exposures for up to a 10-hour work shift unless designated (c) for ceiling, which should not be exceeded, even for a brief period of time.

TABLE II

General Area Air Concentrations

Case Power and Equipment
Bolingbrook, Illinois

January 21, 1983

Contaminant	Sampling Time (Minutes)	Concentration*
Hydrocarbons	9:49am - 1:39pm (230)	27 ppm
Carbon Dioxide	9:49am - 1:39pm (230)	1340 ppm
Carbon Monoxide	9:49am - 1:39pm (230)	49 ppm
Sulfur Dioxide	9:49am - 1:39pm (230)	no trace

* All air concentrations are expressed as parts of contaminant per million parts (ppm) of air.

Table III

General Area and Personal Breathing Zone Air Concentrations of Carbon Monoxide

Case Power and Equipment
Bolingbrook, Illinois

March 18, 1983

Location	Sampling Time (Minutes)	Carbon monoxide Conc. (sample duration)	Carbon monoxide Conc. (8-hour TWA)
Area	366 min.	8.3 ppm	6.3 ppm
Area	363 min.	7.8 ppm	5.9 ppm
Mechanic #1	369 min.	5.4 ppm	4.2 ppm
Mechanic #2	303 min.	3 ppm	1.9 ppm

* All air concentrations are expressed as parts of contaminant per million parts (ppm) of air.

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