U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH

Health Hazard Evaluation Report

HETA 84-281-1607
FEDERAL GRAIN INSPECTION SERVICE-USDA
NEW ORLEANS, LOUISIANA

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 84-281-1607
July 1985
FEDERAL GRAIN INSPECTION SERVICE-USDA
NEW ORLEANS, LOUISIANA

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I. SUMMARY

On April 16, 1984, the National Institute for Occupational Safety and Health (NIOSH) was requested by the United States Department Agriculture (USDA) Federal Grain Inspection Service (FGIS) to evaluate grain fumigant exposures of grain samplers and inspectors in the Bel Chasse, and Destrehan Field Office.

FGIS workers are required to collect representative grain samples from outgoing grain shipments at the export elevators and to test and inspect the sample. The tests include a "sniff test" which requires the inspector to inhale the air directly above a sample of grain.

October 15-17, 1984 NIOSH investigators conducted an initial survey with a follow-up survey on December 11-13, 1984. Evaluation of worker exposure to fumigants and other workplace contaminants was conducted primarily by personal exposure monitoring. Contaminants evaluated were: phosphine, malathion, carbon disulfide, carbon tetrachloride, grain dust, and noise.

Personal exposure to carbon tetrachloride during the follow-up survey had a maximum of 1.7 milligrams per cubic meter (mg/m^3). The Occupational Safety and Health Administration's (OSHA) 8-hour time-weighted average (TWA) permissible exposure limit (PEL) is 10 mg/m^3. No personal or area exposures to phosphine, malathion, or carbon disulfide were documented. Personal and area grain dust samples ranged from 0.1 to 2.7 mg/m^3. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) for grain dust is 4 mg/m^3. Personal and area noise measurement were all below 82 decibels on the A weighted scale and did not indicate any excessive noise levels.

Based on the environmental sample results and available toxicological information, NIOSH investigators concluded that a health hazard for carbon tetrachloride, phosphine, malathion, and carbon disulfide did not exist at the time of the survey on December 11-13, 1984. Recommendations to aid in providing a safe and healthful working environment are presented in Section VIII of this report.

KEYWORDS: SIC 4782 (Inspection and Weighing Services connected with transportation, grain inspection, grain fumigants, sniff test, Phophine-cas #20859-73-8, Malathion-cas #121-75-5, Carbon Disulfide-cas #75-15-0, Carbon Tetrachloride-cas #56-23-5, Grain Dust, Noise, Grain Elevators-Export).

II. INTRODUCTION

On April 16, 1984 The National Institute for Occupational Safety and Health received a request from the United States Department of Agriculture Federal Grain Inspection Service to evaluate exposure to fumigants at grain sampling and inspection stations operated by the field offices in the New Orleans, Louisiana area.

During the week of October 15, 1984 a NIOSH team conducted an initial walk through survey at the FGIS inspection sites served by Bel Chasse and Destrehan field offices. They included Continental, Public and Mississippi River Grain Elevators in Bel Chasse, Louisiana and St. Charles, Bunge and Farmers Export Elevators in Destrehan, Louisiana. At that time information was collected on the history of the elevators, types of grain exported, characteristics of current workforce, types of fumigants used, and fumigation practices and FGIS' experience with fumigated grain shipments for these field offices.

During the tour of the elevators it was reported that 95-99 percent of the incoming grain was barge traffic and the balance was trucks and rail cars. Corn, wheat, soybean, and sorghum were the most common grains. Malathion, phostoxin, and carbon disulfide-carbon tetrachloride (80/20) based grain fumigants were used. A total of four to six FGIS employees were located at each elevator. The six grain elevators visited use automated grain sampling procedures almost exclusively.

A follow up survey was conducted the week of December 10, 1984 (during a period of increased grain movement) in an effort to define exposures and evaluate conditions which would be considered more representative of heavy grain traffic with a potentially greater incidence of fumigated shipments.

III. BACKGROUND

A. Federal Grain Inspection Service

The U.S. Grain Standard Act requires that (with some exceptions) all U.S. export grain undergo inspection as it is loaded on board the vessel that will carry it overseas. The inspection is performed by FGIS or by state agencies that have been delegated export inspection authority. The Federal Grain Inspection Service currently performs all grain inspections required under law for grain moving into the state for export.

FGIS grain samplers and inspectors in these two field offices are represented by the American Federation of Government Employees-Local 3157.

B. Process Description

The six grain elevators visited used automated grain sampling procedures almost exclusively. This is a mechanical sampling device that periodically passes through the grain flow on its way into the elevator and directs it through a series of tubes to a collection point in the FGIS laboratory.

The sample, upon delivery to the laboratory, is weighed and then split into various fractions for inspection. A divider is used to separate the sample into a 1000 gram (g) work sample and a 1000 g file sample. A 250 g sample used for moisture determination is also obtained. Inspectors have reported experiencing fumigant odors during sample division on the Boerner® divider. The 1000 g working sample is then run through a dockage tester which removes the trash (chaff, weed seeds, stones, etc.) from the grain. The weight of grain per bushel is determined from this sample.

The subsamples obtained from the dockage tester are used in the percentage analysis where total defects, heat damage, and odor are determined. Odor is determined by conducting a "sniff test" which requires the inspector to place his/her nose immediately above the grain sample and check for a sour or musty grain odor. This procedure results in direct inhalation exposure of the inspector to residual fumigants which may be present in the grain. The remaining 250 g sample is placed on a grain sizer which separates out broken and shrunken kernels. Grain perceived as fumigated is permitted to sit for four hours prior to inspection and the sniff test, but after it has passed through the splitter and dockage tester, to allow for offgassing of fumigants. The sample is placed off to the side or on an unused work bench area during this time. No local exhaust ventilation is present in the grain inspection laboratories.

IV. METHODS

During the follow-up survey our exposure monitoring for carbon disulfide and carbon tetrachloride was conducted with portable, battery-operated sampling pumps each equipped with a manifold permitting the collection of three simultaneous samples per worker. Standard 150 milligram charcoal tubes were used for the collection media and the approximate flow rate through each sorbent tube was 0.2 liters per minute (LPM) for near full-shift sampling. Two of the three tubes were analyzed from each sample set. The third tube was retained until after laboratory analyses were completed, allowing an extra sample from each set in the event that additional compounds of interest requiring further analyses were identified.

Personal and area samples for phosphine were collected on 150 milligram mercuric cyanide coated silica gel tubes using a battery-powered pump at a flow rate of 0.2 LPM.

Personal and area samples for malathion were collected on glass fiber filters using a battery-powered pump at a flow rate of 2.0 LPM.

Personal and area grain dust samples were collected on preweighed FWSB filters using a battery-powered pump at a flow rate of 2.0 LPM.

Carbon Disulfide was analyzed by gas chromatography using NIOSH method S-248[1] with modifications..

Carbon Tetrachloride was analyzed by gas chromatography according to NIOSH method P&CAM 127[2] with modifications.

Phosphine samples were analyzed by visible spectroscopy according to NIOSH method S-332[3].

Malathion samples were analyzed on a tracor 222 gas chromatograph equipped with an electron capture detector.

The total weight of each grain dust sample was determined by weighing the sample plus the filter on an electrobalance and subtracting the previously determined tare weight of the filter. The tare gross weighings were done in duplicate.

A noise survey was conducted using a General Radio 1982 precision sound level meter and Metrosonics 301® dosimeters. The units were calibrated before and after each day's use.

V. EVALUATION CRITERIA AND TOXICITY SUMMARIES

A. Environmental 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 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 evalaution 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 recommendations 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 primarily on concerns relating to the prevention of occupational disease. In reviewing the exposure levels and the recommendations for reducing those levels found in this report, it should be noted that industry is required by the Occupational Safety and Health Act of 1970 to meet those levels specified by OSHA standards.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8 to 10 hour workday. Some substances have recommended 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.

B. Toxicity Discussion:

1. Carbon Tetrachloride

Carbon tetrachloride (CCl_4) vapor is a narcotic and causes severe damage to the liver and kidneys. In animals the primary damage from intoxication is to the liver, but in humans the majority of fatalities have been the result of renal injury with secondary cardiac failure. In humans, liver damage occurs more often after ingestion of the liquid than after inhaling the vapor. Human fatalities from acute renal damage have occurred after exposure for about one-half to one-hour at concentrations of 1000 (ppm) parts per million to 2000 ppm. Exposure to high concentration results in symptoms of central nervous system depression including dizziness, vertigo, incoordination, and mental confusion; abdominal pain, nausea, vomiting and diarrhea are frequent. Within a few days, jaundice may appear and liver injury progresses to toxic necrosis. There are several reports of adverse effects in workmen who were repeatedly exposed to concentrations between 25 and 30 ppm; nausea, vomiting, dizziness, drowsiness, and headache were frequently noted. The effects of CCl_4 in humans who are addicted to alcohol are more severe than usual. No adverse symptoms resulted from repeated exposure to 10 ppm. Hepatomas have been reported in several animal species exposed to carbon tetrachloride; human exposure has also been associated with hepatomas.[4] Liquid CCl_4 can be absorbed through the skin.[5]

The current OSHA PEL for CCl_4 is 10 ppm over an eight-hour TWA with an acceptable ceiling concentration of 25 ppm and a maximum acceptable peak of 200 ppm for five minutes occurring only once in any four hours and included in the overall TWA calculation.[6]

NIOSH recommends that the TWA exposure limit to CCl_4 be maintained below 2 ppm (12.6 mg/m^3) during the course of a workshift determined during a one-hour sampling period. Maintaining exposures below this level is considered capable of greatly reducing the cancer risk associated with occupational exposure to CCl_4. NIOSH recommends that CCl_4 be regulated as an occupational carcinogen.

Carbon tetrachloride has an odor threshold of about 50ppm, which is above the PEL and is, therefore, regarded as having poor warning properties. Carbon tetrachloride has been reported as being slightly irritating to the eyes, however, no concentrations at which this occurs were or have been given.[4]

2. Grain Dust

Grain dust inhalation may cause three major respiratory diseases: asthma, chronic bronchitis, and grain fever.

Both immediate and delayed asthmatic reactions have been reported when asthmatic grain handlers were given bronchial challenges of grain dust extracts. Estimation of the prevalence of asthma among grain handlers is difficult due to self exclusion of symptomatic workers from grain dust exposure. The long-time asthmatic grain handlers represent a surviving population.[7]

Workers exposed to grain dust demonstrate a higher prevalence of respiratory symptoms and rhonchi (abnormal chest sounds) than in control populations, regardless of smoking history. Inhalation of grain dust causes coughing, expectoration, wheezing, chest tightness, and shortness of breath. Grain handlers with symptoms had impaired lung functions. This impairment was either of the same magnitude as that of cigarette smoking or of lesser extent. The prevalence of chronic bronchitis with respiratory obstruction was higher in grain handlers regardless of smoking. Chronic bronchitis with evidence of airway obstruction was related to the length of employment. Chronic bronchitis is considered a major occupational health problem among grain handlers. Although smoking is a major contributing factor to this disease, it also occurs in nonsmokers.[7]

The incidence of grain fever has been stated to range from 19 to 40% in grain handlers. Its occurrence is determined largely by excessively dusty conditions, i.e., dust concentrations exceeding 15 mg/m^3.[7]

Grain workers exposed to time weighted average grain dust concentrations of 4 mg/m^3 or less generally do not express respiratory symptoms in excess of those reported among control populations.[7] This is the basis of the ACGIH recommended TLV® of 4 mg/m^3 for total dust.

3. NOISE

Exposure to intense noise causes hearing losses which may be temporary, permanent, or a combination of the two. These impairments are reflected by elevated thresholds of audibility for discrete frequency sounds, with the increase in decibels (dB) required to hear such sounds being used as a measure of the loss. Temporary hearing losses, also called auditory fatigue, represent threshold losses which are recoverable after a period of time away from the noise. Such losses may occur after only a few minutes of exposure to intense noise. With prolonged and repeated exposures (months or years) to the same noise level, there may be only partial recovery of the threshold losses, the residual loss being indicative of a developing permanent hearing impairment.

The losses in hearing due to exposure to intense occupational noise (105 dB(A) or above) tend to reach a plateau at certain frequencies (most notably 4000 Hertz) after about 10 years of exposure. The hearing loss for such frequencies, which result from a 10-year exposure to noise, appears to approximate the temporary hearing loss resulting from a single day's exposure.[8]

The OSHA PEL for continuous noise exposure is 90 dB(A) for a duration of eight hours per day. NIOSH and the ACGIH recommend that the daily noise exposure or dose not exceed 85 dB(A) over an eight-hour work shift. The ACGIH also recommends the inclusion of all on-the-job noise exposures of 80 dB(A) or greater in calculating daily noise exposure.

VI. RESULTS AND DISCUSSION

Results of the air samples collected for fumigants and grain dust are presented in Tables 1 through 6. A total of 83 samples were collected: 65 personal and 18 area samples in six elevators in the New Orleans, Louisiana area. A total of 60 personal exposure and 10 area samples for phosphine, malathion, carbon disulfide, and carbon tetrachloride were collected over the workers' full work shift. A total of 13 (five personal and eight area), air samples were collected for grain dust.

Twenty six personal exposure and one area samples were collected for carbon tetrachloride. The four personal exposure (grader, rover, sampler, and weigher) at the Mississippi River Elevator ranged from 1.0 to 1.7 mg/m^3. The OSHA 8-hour TWA PEL is 10 mg/m^3. All other samples were below the analytical limit of detection 30 micrograms per sample, equivalent to 0.01 ug/m^3 for volume of air samples.

A total of six personal exposure and five area samples were collected for phosphine in the six elevators. None of these samples documented the presence of any phosphine during the follow-up survey. The analytical limit of detection was one microgram per sample, equivalent to 0.09 ug/m^3 for volume of air samples.

Six personal exposure and three area samples were collected for malathion in the six elevators. None of these samples documented the presence of malathion during the follow-up survey. The analytical limit of detection was 10 micrograms per sample, equivalent to 0.06 ug/m^3 for volume of air samples.

Twenty two personal exposure and one area sample were collected for carbon disulfide in the six elevators. None of these samples documented the presence of carbon disulfide during the follow-up survey. The analytical limit of detection was 30 micrograms per sample, equivalent to 0.01 ug/m^3 for volume of air samples.

Five personal exposure and eight area samples were collected for grain dust. The personal samples concentrations ranged from 0.1 to 2.7 mg/m^3. The highest concentration (2.7 mg/m^3) was the grader at the Continental Elevator. The area samples concentration ranged from 0.2 to 2.7 mg/m^3 with the highest area sample (2.7 mg/m^3) in the laboratory of Farmers Export Elevator. The ACGIH TLV® for grain dust is 4 mg/m^3.

Noise level results represent an 8-hour time weighted average exposure obtained with noise dosimeters. The highest personal noise level exposure was for the rover supervisor at Continental Elevator. His personal noise exposure was 82 dB(A). All other 8-hour average dosimeter measurements were below 80 dB(A) at the other five elevators.

VII. CONCLUSIONS

Results of the air samples collected for phosphine, malathion, carbon disulfide, carbon tetrachloride, and grain dust are presented in Tables 1 through 6. No personal or area overexposure to fumigant vapors were documented during this investigation. Four personal exposures (grader, rover, sampler, and weigher) for carbon tetrachloride at Mississippi River Elevator ranged for 1.0 to 1.7 mg/m^3 with a mean of 1.3 mg/m^3; the OSHA 8-hour TWA PEL is 10 mg/m^3. Personal and area samples (13 samples) collected for grain dust ranged from 0.1 to 2.7 mg/m^3 with a mean of 1.0 mg/m^3. The ACGIH TLV® for grain dust is 4 mg/m^3. Noise levels results with the 8-hour average dosimeter measurement were below 82 dB(A).

The low levels of fumigant exposure to the workers can be attributed to the following; 1) barge traffic (95-99 percent) versus trucks and rail cars 2) The period of time fumigants are stored in the barge before being unloaded at the grain elevators and 3) automated grain sampler used in place of manually inserting the probe into the grain of barges, rail cars and trucks.

Based on the environmental results, available toxicological information, and NIOSH health hazard evaluation reports[9] at other grain elevators, it is concluded a health hazard did not exist at the time of this survey on December 11-13, 1984.

VIII. RECOMMENDATIONS

1. Elevator managers and operators should routinely elicit information on fumigant treatment of incoming grain prior to its arrival at the elevator.

2. Development of methods which assure quick, effective, and economic removal of fumigants from treated grain.

3. Development of both equipment and strategies for evaluating incoming suspect grain shipments for the identification and quantitation of fumigant content.

4. Determination of the best approach in evaluating fumigated grain, to insure that a health risk to workers handling the grain will not occur.

5. Workers using indicator tubes to assess fumigant concentrations should be trained in the use of such equipment and also be made aware of their limitations.

6. An alternative method of evaluating grain for sourness or mustiness should be implemented, phasing out the conventional sniff test, or at least reserving the sniff test for contested or non-routine grading procedures.

7. Enclosure of the Boerner® divider below the drop at the location where grain cascades over the internal cone should be provided to reduce dust and fumigant release into the operators breathing zone. Depending upon the material used to achieve this, the amount of noise generated may also be reduced slightly.

8. Development of a registry of grain handlers and inspectors along with descriptive job elements which will permit long term surveillance of the group tied in with occupational history.

IX. REFERENCES

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. U.S. Federal Grain Inspection Service
2. USDA Federal Grain Inspection Service-Bel Chasse Field Office
3. USDA Federal Grain Inspection Service-Destrehan Field Office
4. American Federation of Government Employees-Local 3157
5. American Federation of Government Employees-Washington D.C.
6. NIOSH, Region VI
4. OSHA, Region VI

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 1

EXPOSURE OF FEDERAL GRAIN INSPECTION SERVICE WORKERS TO PHOSPHINE, MALATHION, CARBON DISULFIDE, CARBON TETRACHLORIDE AND TOTAL PARTICULATE

FARMERS EXPORT ELEVATOR-DESTREHAN FIELD OFFICE
HETA 84-281
December 11, 1984

Job and/or Location	Sampling Period	Phosphine mg/m^3*	Malathion mg/m^3	Carbon Disulfide mg/m^3	Carbon Tetrachlorine mg/m^3	Grain Dust mg/m^3
Grader	0705-1500	-	-	ND**	ND	-
Grader	0708-1432	-	-	ND	ND	-
Rover	0716-1429	-	-	ND	ND	-
Rover	0715-1429	-	ND	-	-	-
Sampler	0710-1655	-	-	ND	ND	—
Laboratory (area)	0722-1503	ND	-	-	-	-
Laboratory (area)	0727-1505	-	-	-	-	0.5
Laboratory (area)	0727-1505	-	-	-	-	2.7
Environmental Criteria (mg/m^3)		0.4	10	30	30	4
Analytical limit of Detection in micrograms per sample:		1	0.06	10	10	10

*mg/m^3 = Milligrams of substance per cubic meter of air sampled
**ND = Indicates sample concentration was below the given analytical limit of detection for that substance.

TABLE 2

EXPOSURE OF FEDERAL GRAIN INSPECTION SERVICE WORKERS TO PHOSPHINE, MALATHION, CARBON DISULFIDE, CARBON TETRACHLORIDE, AND TOTAL PARTICULATE

MISSISSIPPI RIVER ELEVATOR-BEL CHASSE FIELD OFFICE
HETA 84-281
DECEMBER 11, 1984

Job and/or Location	Sampling Period	Phosphine mg/m^3*	Malathion mg/m^3	Carbon Disulfide mg/m^3	Carbon Tetrachloride mg/m^3	Grain Dust mg/m^3
Grader	0755-1505	-	-	ND	1.7	-
Rover	0749-1450	ND	ND	ND	1.3	-
Sampler	0741-1505	-	-	ND	1.0	-
Weigher	0756-1505	-	-	ND	1.1	-
Laboratory (area)	0815-1505	ND	-	-	-	0.2

TABLE 3

EXPOSURE OF FEDERAL GRAIN INSPECTION SERVICE WORKERS TO PHOSPHINE, MALATHION, CARBON DISULFIDE, CARBON TETRACHLORINE AND TOTAL PARTICULATE

ST. CHARLES ELEVATOR - DESTREHAM FIELD OFFICE
HETA 84-281
December 12, 1984

Job and/or Location	Sampling Period	Phosphine mg/m^3	Malathion mg/m^3	Carbon Disulfide mg/m^3	Carbon Tetrachlorine mg/m^3	Grain Dust mg/m^3
Grader	0704-1454	-	-	ND	ND	-
Grader	0706-1452	-	-	ND	ND	-
Rover	0658-1449	-	-	ND	ND	-
Rover	0738-1444	ND	-	-	-	-
Rover	0658-1444	-	ND	-	-	-
Sampler	0658-1450	-	-	ND	ND	-
Laboratory (area)	0708-1453	ND	-	-	-	-
Laboratory (area)	0709-1453	-	ND	-	-	-
Laboratory (area)	0720-1447	-	-	-	-	0.7
Laboratory (area)	0719-1448	-	-	-	-	0.3
Environmental Criteria (mg/m^3)		0.4	10	30	30	4
Analytical Limit of Detection in micrograms per sample:		1	0.06	10	10	10

*mg/m^3 = Milligrams of substance per cubic meter of air sampled.
**ND = indicates sample concentration was below the given analytical limit of detection for that substance.

TABLE 4

EXPOSURE OF FEDERAL GRAIN INSPECTION SERVICE WORKERS TO PHOSPHINE, MALATHION, CARBON DISULFIDE, CARBON TETRACHLORDE AND TOTAL PARTICULATE

PUBLIC ELEVATOR - BEL CHASSE FIELD OFFICE
HETA 84-281
December 12, 1984

Job and/or Location	Sampling Period	Phosphine mg/m^3	Malathion mg/m^3	Carbon Disulfide mg/m^3	Carbon Tetrachloride mg/m^3	Grain Dust mg/m^3
Grader	0740-1415	-	-	ND**	ND	-
Rover	0738-1415	ND	ND	ND	ND	-
Sampler	0750-1022	-	-	ND	ND	-
Weigher	0746-1430	-	-	ND	ND	0.1
Laboratory (area)	0802-1400	ND	ND	ND	ND	0.3
Environmental Criteria (mg/m^3)		0.4	10	30	30	4
Analytical Limit of Detection in micrograms per sample:		1	0.06	10	10	10

*mg/m^3 = Milligrams of substance per cubic meter of air sampled
**ND = indicates sample concentration was below the given analytical limit of detection for that substance

TABLE 5

EXPOSURE OF FEDERAL GRAIN INSPECTION SERVICE WORKERS TO PHOSPHINE, MALATHION, CARBON DISULFIDE, CARBON TETRACHLORIDE AND TOTAL PARTIUCLATE

CONTINENTAL ELEVATOR - BEL CHASSE FIELD OFFICE
HETA 84-281
DECEMBER 13, 1984

Job and/or Location	Sampling Period	Phosphine mg/m^3*	Malathion mg/m^3	Carbon Disulfide mg/m^3	Carbon Tetrachloride mg/m^3	Grain Dust mg/m^3
Grader	0728-1446	-	-	-	-	2.7
Grader	0718-1452	-	-	ND**	ND	-
Grader	0728-1446	-	-	-ND	ND	-
Rover (Supervisor)	0715-1445	ND	ND	ND	ND	-
Rover	0712-1515	ND	-	ND	ND	0.7
Sampler	0720-1455	-	-	ND	ND	-
Sampler	0735-1455	-	-	-	-	2.2
Weigher	0733-1500	-	-	ND	ND	-
Laboratory (area)	0740-1445	-	-	-	-	0.6
Environmental Criteria (mg/m^3)		0.4	10	30	30	4
Analytical limit of detection in micrograms per sample:		1	0.06	10	10	10

*mg/m^3 = Milligrams of substance per cubic meter of air sampled
**ND = indicates sample concentration was below the given analytical limit of detection for that substance.

TABLE 6

EXPOSURE OF FEDERAL GRAIN INSPECTION SERVICE WORKERS TO PHOSPHINE, MALATHION, CARBON DISULFIDE, CARBON TETRACHLORIDE AND TOTAL PARTICLATE

BUNGE ELEVATOR - DESTREHAN FIELD OFFICE
HETA 84-281
December 13, 1984

Job and/or Location	Sampling Period	Phosphine mg/m^3	Malathion mg/m^3	Carbon Disulfide mg/m^3	Carbon Tetrachloride mg/m^3	Grain Dust mg/m^3
Grader	0701-1445	-	-	ND**	ND	-
Grader	0655-1447	-	-	-	ND	-
Grader	0655-1447	-	-	ND	-	-
Rover	0655-1452	-	-	ND	ND	-
Rover	0655-1452	-	ND	-	-	-
Rover	0655-1452	ND	-	-	-	-
Sampler	0713-1443	-	-	-	-	0.5
Sampler	0703-1444	-	-	ND	ND	-
Laboratory (area)	0724-1458	-	-	-	-	1.3
Laboratory (area)	0713-1455	-	ND	-	-	-
Laboratory (area)	0713-1455	ND	-	-	-	-
Environmental Criteria (mg/m^3)		0.4	10	30	30	4
Analytical limit of detection in micrograms per sample:		1	0.06	10	10	10

*mg/m^3 = Milligrams of substance per cubic meter of air sampled
**ND = indicates sample concentration was below the given analytical limit of detection for that substance.