NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2005-0271-2996
Threemile Canyon Farms, Columbia River Dairy
Boardman, Oregon

April 2006

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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 employers 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.

HETAB also provides, upon request, technical and consultative assistance 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. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

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Copies of this report have been sent to employee and management representatives at Threemile Canyon Farms and the OSHA Regional Office. This report is not copyrighted and may be freely reproduced. The report may be viewed and printed from the following internet address: http://www.cdc.gov/niosh/hhe. Copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161.

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.

Highlights of the NIOSH Health Hazard Evaluation

On June 14, 2005, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request by employees of Threemile Canyon Farms in Boardman, Oregon regarding concerns about exposure to ammonia, hydrogen sulfide, and dust. NIOSH investigators conducted an investigation in August 2005.

What NIOSH Did

- We took personal breathing zone and area air samples for ammonia and hydrogen sulfide.
- We observed work practices.
- We conducted employee interviews.
- We reviewed the OSHA injury/illness log and worker's compensation records.

What NIOSH Found

- The concentration of ammonia was within recommended levels.
- The concentration of hydrogen sulfide was within recommended levels.
- Some employees had upper airway/mucosal irritation symptoms such as tearing eyes, coughing, and sneezing which were attributed to road dust.
- Employees did not always use personal protective equipment.

What Threemile Canyon Farms' Columbia River Dairy Managers Can Do

- Maintain and change out air filters on heavy equipment cab ventilation systems on a scheduled basis.
- Continue to take steps to control the dust levels by utilizing dust suppression techniques.
- Provide fog-resistant face shields for employees whose work presents a potential for chemical splashes.

What the Threemile Canyon Farms' Columbia River Dairy Employees Can Do

- Wear the required personal protective equipment for the job you are performing.

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2005-0271-2996

Health Hazard Evaluation Report 2005-0271-2996
Threemile Canyon Farms, Columbia River Dairy
Boardman, Oregon
April 2006

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SUMMARY

On June 14, 2005, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at Threemile Canyon Farms, Columbia River Dairy in Boardman, Oregon. The requestors reported health effects such as cough, sore throat, throat infection, burning eyes, dizziness, and headache and concerns about exposure to chemicals such as ammonia and hydrogen sulfide, and exposure to dust. During a site visit on August 9-11, 2005, we collected personal breathing zone (PBZ) and area air samples for ammonia and hydrogen sulfide using a combination of three direct reading methods. Additionally, we observed employee health practices and conducted confidential medical interviews on 56 randomly selected employees out of about 275 employees.

Time-weighted average (TWA) concentrations of ammonia ranged from 2 to 8 parts per million (ppm), below the NIOSH recommended exposure limit (REL) of 35 ppm for a TWA up to 10 hours. Peak ammonia concentrations ranged from non-detectable to 9 ppm, below the NIOSH short-term exposure limit (STEL) of 35 ppm. Concentrations of hydrogen sulfide ranged from 1 to 2 ppm as a TWA. The two highest peaks, 10 ppm and 14 ppm, each lasted for one minute. These correspond to 10-minute average concentrations of 5.5 ppm and 6.1 ppm, below the NIOSH 10-minute ceiling limit of 10 ppm and the OSHA ceiling limit of 20 ppm. Although air sampling was not conducted for nuisance dust (particulates not otherwise regulated), trucks were observed spraying water on the dirt roads; this was a good attempt to reduce the amount of dust generated. In interviews, most employees thought their symptoms were related to road dust and that dust masks helped to reduce their symptoms. We also observed that some employees did not wear eye protection while pouring bleach solutions, reportedly because the safety glasses easily fogged.

The most predominant symptom, burning/watery eyes, was reported by 23 of the 56 employees (41%). Thirteen people reported burning/itching of the throat (23%), eleven (20%) reported sneezing and ten (18%) burning/itching nose. Seven persons (12%) reported at least one episode of rash, five (9%) reported cough and excessive phlegm, and four (7%) complained of episodic chest tightness. Although there were two people with adult-onset asthma they did not associate their symptoms with the work environment.

NIOSH investigators concluded that the ammonia, hydrogen sulfide, and dust levels measured or observed do not pose a health hazard. We identified a potential for chemical splash during the handling of bleach and recommended that face shields be made available to employees and that employees with potential for exposure be required to use them.

Keywords: NAICS 112120, dairy farm, cows, ammonia, hydrogen sulfide, dust, cough, sore throat, burning eyes, dizziness

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INTRODUCTION

On June 14, 2005, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at Threemile Canyon Farms' Columbia River Dairy in Boardman, Oregon. The requestors reported health effects such as cough, sore throat, throat infection, burning eyes, dizziness, and headache and concerns about exposure to dust and chemicals such as ammonia (NH_3) and hydrogen sulfide (H_2S). In response to this request, two NIOSH medical officers and two NIOSH industrial hygienists visited the facility on August 9-11, 2005. The visit included an opening conference, a tour of the farm, observations of work practices, exposure monitoring, and confidential employee interviews.

BACKGROUND

Created in 1978, the 93,000-acre Threemile Canyon Farm is located west of Boardman, about 150 miles east of Portland. The farm is bordered on the west by grassland, on the east by a 40,000-acre US Navy bombing range, on the south by a wheat farm, and on the north by the Columbia River. It includes a 35,000-acre crop farm and a 180-acre dairy operation that has the Threemile, Sixmile, Jersey, and Holstein barns situated in the middle. Farm management was taken over by Threemile Canyon Farms in 1998, which currently employs 175 dairy farmers and approximately 100 crop farmers.

The dairy farm has about 16,000 dairy cows that produce more than 160,000 gallons of milk daily. In addition, the farm also has 21,000 heifers and a 4,000-calf nursery. The cows are held in open free-style pens with 2,000 cows in each pen. The barns are flushed daily with recycled water, and the slurry is discharged into settling cells and ultimately into one of two lined lagoons. The water from the lagoon is used to irrigate the crop farm while the sediment is composted and then applied to crops or sold. The lagoon is dredged daily for 3 months every year.

The crop farm produces about 200,000 tons of potatoes annually as well as onions, alfalfa, corn, mint, and wheat. The alfalfa and the peels from the potatoes are fed to the cows.

The sources of the ammonia and hydrogen sulfide stem from the waste products produced by the large number of cows on the farm. The hydrogen sulfide is formed as a byproduct of animal waste as organic sulfur-containing materials undergo natural decomposition. Ammonia is produced during the decomposition of organic forms of nitrogen present in the feces as well as the conversion of urea, mainly found in the urine.

METHODS

Medical

We randomly selected 56 workers out of about 275 for confidential medical interviews. Twenty-four workers were from the Holstein and Jersey dairy farms, sixteen were from Sixmile dairy farm, nine were from Threemile dairy farm and the remaining seven were from the crop farm. We administered questionnaires to each participant to inquire about symptoms, work history, and practices at the farm. The questionnaire was written and administered by NIOSH investigators in Spanish except for employees who expressed some degree of comfort with English.

We also obtained and reviewed the farm's workers' compensation report for 2005 and the OSHA injuries and illnesses logs for the past 5 years.

Industrial Hygiene

On August 9, 2005, we toured the agricultural and dairy operations at Threemile Canyon Farms. The dairy operations included the Holstein and Jersey milking barns, the holding pens, the breeding operations, and the lagoons holding the manure slurry. We observed employee work practices at these locations and

spoke with workers about the training they received, their concern for potential hazards, and their use of personal protective equipment.

On August 9-11, 2005, we collected personal breathing zone (PBZ) and area air samples for ammonia and hydrogen sulfide, compounds produced during the decomposition of cow manure. We used a combination of three direct reading methods for these samples – passive diffusion monitors, colorimetric detector tubes, and a multi-gas detector. The first method used the Biosystems Inc. ToxiUltra Gas Detector (Middletown, Connecticut) passive diffusion monitors. For personal samples, we placed the monitor in the PBZ of the worker being monitored during part or all of the work shift. These monitors recorded either ammonia or hydrogen sulfide concentrations during the work shift; continuous readings were integrated every 60 seconds and then logged by each monitor. The recorded measurements were then downloaded to a computer. The monitor measures ammonia concentrations from 0-50 parts per million (ppm) or hydrogen sulfide concentrations from 0-100 ppm. We calibrated these monitors before and after sampling according to the manufacturer's specifications.

For the second sampling method, we used a bellows pump and colorimetric detector tubes (Dräger®, Inc., Pittsburgh, Pennsylvania) for ammonia and hydrogen sulfide area samples. These detector tubes have measuring ranges of 2.5 to 100 ppm for ammonia and 2 to 60 ppm for hydrogen sulfide.

The third method involved using a GasAlertMax multi-gas detector (BW Technologies Inc., Arlington, Texas) for hydrogen sulfide. The device's electrochemical sensor has a measuring range of 0-100 ppm.

We collected samples at the waste-containing lagoon during dredging operations, the pens where the dairy cows were kept between milkings, the composting area, and the milking operation.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the 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 even though 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 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 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 Recommended Exposure Limits (RELs),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[2] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[3] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are

likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91–596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

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 STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Ammonia

Ammonia is a severe irritant of the eyes, respiratory tract, and skin. It may cause coughing, burning, and tearing of the eyes; runny nose; and chest pain. Symptoms may be delayed in onset. Very high concentration may cause cessation of respiration and possibly death. Exposure of the eyes to high gas concentrations may produce temporary blindness and severe eye damage. Exposure of the skin to high gas concentrations may cause burning and blistering. Repeated exposure to ammonia gas may cause chronic irritation of the eyes and upper respiratory tract.[4,5] The NIOSH REL for ammonia is 25 ppm for up to a 10-hour TWA. The NIOSH STEL for ammonia is 35 ppm. The ACGIH TLV is 25 ppm as an 8-hour TWA, with a STEL of 35 ppm. The OSHA PEL is 50 ppm for an 8-hour TWA.

Hydrogen Sulfide

Hydrogen sulfide is a colorless, flammable gas with a strong odor of rotten eggs. The smell is faint, but easily perceptible at 0.77 ppm and offensive at 3 to 5 ppm. Up to about 30 ppm, it smells of rotten eggs, but at about 30 ppm the smell is described as sweet or sickening sweet. At 150 ppm, hydrogen sulfide causes olfactory nerve paralysis and the smell is no longer perceptible; for this reason, the sense of smell is not a reliable warning of its presence, especially at high concentrations.

Acute airborne exposures to hydrogen sulfide above 10 ppm have been associated with eye disorders, including conjunctivitis and keratitis.[6] One-hour exposure to concentrations between 50 and 100 ppm can produce mild eye and respiratory irritation, which becomes markedly worse when the concentrations rise to the 200 to 300 ppm range. At concentrations between 500 and 700 ppm, exposures for 0.5 to 1 hour can result in unconsciousness and death. At very high concentrations (1000 to 2000 ppm or more), unconsciousness and death can occur within minutes. While conclusive evidence of adverse health effects from chronic exposure at concentrations below 20 ppm is lacking,[1,3,7-9] there is some evidence that hydrogen sulfide at low concentrations, either alone or in combination with other chemical substances, is associated with eye irritation and disorders of the nervous, cardiovascular, and gastrointestinal systems. Repeated exposure to hydrogen sulfide results in increased susceptibility, so that eye irritation, cough, and systemic effects may result from concentrations previously tolerated without effect.

The NIOSH REL for hydrogen sulfide is a 10-minute ceiling concentration of 10 ppm.[1] The OSHA standard is a ceiling concentration of 20 ppm or a maximum allowable one-time peak of 50 ppm for 10 minutes, if no other measurable exposures occur.[3] The ACGIH® recommends a TLV® of 10 ppm as an 8-hour TWA and a STEL of 15 ppm.[2] The TLV and STEL are both currently being reviewed by ACGIH for possible reduction to 1 ppm for the TWA and 5 ppm for the STEL, based on consideration of upper respiratory and central nervous system health effects. The concentration of hydrogen sulfide considered by NIOSH to be immediately dangerous to life and health is 100 ppm.

Dust

Farm workers and others involved in agriculture have the potential to be exposed to dust containing inorganic and/or organic fractions.[10]

The inorganic dust exposure comes chiefly from the soil, which has a mineral content typically dominated by silicates, although calcium carbonate dominates in soil in very arid climates. No estimates exist as to the number of farmers significantly exposed to inorganic dust, but variables such as the type of farming and the specific tasks performed by the individual are considered important in the levels of exposure.[10] The constituents of organic dust, that fraction of particulate material of biologic origin, can be a mixture of plant matter, molds and spores, mycotoxins, microorganisms, or allergens.[10] No standards exist for most organic dusts, although OSHA has established non-specific dust standards for particulates not otherwise regulated (PNOR) of 15 milligrams/cubic meter (mg/m^3) for total dust and 5 mg/m^3 for respirable dust.[3] Non-infectious bioaerosols, most of which are common in the agricultural environment, have been shown to be responsible for a variety of pulmonary conditions such as mucous membrane irritation, organic toxic dust syndrome, occupational asthma, and hypersensitivity pneumonitis.[10] Some of the most clinically significant bioaerosol-induced respiratory disease risks in agricultural work are those associated with episodic exposures to very high concentrations of organisms.[10] Endotoxins, biochemical components of certain microorganisms, have also been recognized as an important factor in occupational lung disease caused by organic dust exposure.[10]

RESULTS

Medical

The age range of the 56 employees interviewed was 19 to 66 years with an average age of 31 years. The mean duration of employment at the farm was 2.2 years (range 3 months to 7 years). All but three were men. Of those interviewed, 68% worked the day shift, 30% rotated shifts, and one person worked a permanent night shift.

Most of those reporting symptoms had multiple irritant-type symptoms. The predominant symptom reported was burning/tearing of the eyes, occurring in 23 persons (41%). Other symptoms included burning/itching of the throat in 13 persons (23%), excessive sneezing in 11 (20%), and burning/itching of the nose in 10 (18%). Seven persons (12%) reported at least one episode of rash, five (9%) reported cough and excessive phlegm, and four (7%) complained of episodic chest tightness. Two persons reported adult-onset asthma; however, they did not report that these symptoms were related to work. Most symptoms were reported by workers at the Sixmile dairy farm.

When asked what they believe is responsible for their symptoms, employees related symptoms to multiple exposures, the most frequent of which were dust (reported 18 times), the iodine used to disinfect the teats of the cows prior to milking (7 times), chlorine and manure (4 times each), and other chemicals and cleaning agents (5 times).

Employees were asked about personal protective equipment; 48 workers (86%) reported using gloves, 47 (84%) used aprons/coveralls, 46 (82%) used safety glasses, 45 (80%) wore rubber boots, and 31 (55%) used dust masks on a voluntary basis. Although some workers reported having fewer or no symptoms when they used safety glasses and dust masks, they did not always wear them because the safety glasses became foggy and the dust masks were not always available.

Forty workers (71%) reported having at least one formal safety training session since they commenced work at the farm, 13 (23%) reported having no formal training, and three (5%) did not respond to the question. We were informed by management that a new training tracking system has been started to ensure that all staff are trained. Some employees expressed concern that there are no material safety data sheets (MSDS) in the maintenance shop. This was brought to the attention of management and MSDS are now available in the maintenance shop.

A review of the workers' compensation report for 2005 and the OSHA injury and illness logs for the past 5 years revealed no symptoms/problems consistent with exposure to

hydrogen sulfide or ammonia. Of note were three cases of chemical splash into the face/eyes.

Industrial Hygiene

Sampling results for hydrogen sulfide and ammonia collected August 9-11, 2005, are summarized in Tables 1 and 2. TWA concentrations of ammonia measured by passive diffusion monitors ranged from 2-8 ppm. Peak concentrations ranged from non-detectable to 9 ppm. The ammonia concentrations measured during the 3 days of sampling were below applicable occupational exposure limits.

The TWA concentrations of hydrogen sulfide measured by passive diffusion monitors ranged from 1-2 ppm. Peak concentrations ranged from non-detectable to 14 ppm. The two highest peak concentrations, 10 ppm and 14 ppm, were measured in the PBZ of the lagoon operator on August 9 and 10, respectively. Both these peak concentrations lasted only for one minute; the 10-minute average concentrations were 5.5 ppm and 6.1 ppm hydrogen sulfide, respectively. These are below the NIOSH REL of 10 ppm as a 10-minute ceiling limit and the OSHA PEL of 20 ppm as a ceiling limit. For those samples collected over the full shift, the hydrogen sulfide concentrations measured were below the 8-hour TWA of 10 ppm or 15-minute STEL of 15 ppm, as recommended by the ACGIH TLV.

During the site visit, we observed that vehicular traffic generated a lot of road dust on the farm. Employees reported that the road dust bothered them, and they thought that it was responsible for most of their upper respiratory irritation symptoms and that the use of dust masks helped alleviate this. We also observed that water tankers sprayed water on the roads in an attempt to reduce the amount of road dust generated. This dust suppression process was reported to be a common practice. Heavy equipments such as lagoon dredger and earth movers were also utilized on the farms. However, the operators of these heavy equipments were located inside cabs.

DISCUSSION/ CONCLUSIONS

Our review of the OSHA incident logs and workers' compensation claims found no incident or claim that could be attributed to exposure to hydrogen sulfide or ammonia. Additionally, we found no exposures of ammonia or hydrogen sulfide at or above current occupational exposure limits during our visit. Although hydrogen sulfide concentrations were below occupational exposure limits, direct-reading results obtained during the flushing operation of one of the pens showed higher hydrogen sulfide concentrations near the water as it flushed the stalls of the cows' waste. For example, the concentration of hydrogen sulfide at one foot above the rushing water ranged from 4-6 ppm, while readings taken at shoulder height a few feet away yielded results near non-detectable. This may be the result of hydrogen sulfide remaining near the floor because it is heavier than air, as well as the ability of the fresh air flowing through the open pen to dilute the concentration. Eight-hour sampling conducted by a passive diffusion monitor set at shoulder height in the middle of the pen recorded concentrations of only 1-2 ppm throughout the entire shift. The highest peak exposure to hydrogen sulfide was measured on the lagoon barge operator. However, the open air environment appeared to quickly dilute the concentration as the duration of the peaks lasted no more than a minute during each sampling session.

In the past, NIOSH investigators have documented cases of injury and death of farm workers who were exposed to high levels of hydrogen sulfide, ammonia, methane, and carbon dioxide as described in the NIOSH Alert: Preventing Deaths of Farm Workers in Manure Pits.[11] However, these deaths were the result of entering confined space manure pits and/or tanks without adequate training and PPE. At Threemile Canyon Farm, manure is treated in open-air lagoons and, therefore, the confined space hazards do not occur at this farm. Unlike in confined spaces, gases produced by the

decomposing manure do not build up in the open air environment such as the waste lagoon and the cow pens. Additionally, we were informed that there are no plans by management to add confined-space pits or tanks of this type on the farm.

From the interviews, we identified some individuals who experienced symptoms of mucosal irritation that were predominantly attributed to exposure to road dust at the farm. The high level of aerosolized dust produced on the farm was apparent during the site visit, and workers were concerned about it. Although organic dusts may be associated with farms, from our assessment of the practices on the farm, and employees' expressed concerns, it appears that the dust is predominantly dirt from road traffic rather than organic dust. It is unlikely that dust exposures would exceed OSHA standards for particulates not otherwise regulated. However, should management continue to allow voluntary use of respirators, the respirator use policy should comply with the OSHA standard 1910.134.[12] Appendix D of the standard contains information that is required when voluntary respirator use is permitted.

Our review of the OSHA injury and illness logs revealed three employees with chemical splash to the face/eyes, suggesting that the reported inconsistent use of safety goggles by employees may present a potential for chemical burns to the eyes. Because the reason for inconsistent use was the glasses fogging up, it may be possible to improve compliance by providing employees with fog-resistant face shields.

RECOMMENDATIONS

Based on the environmental data, medical interviews, and the observations during this survey, the following recommendations are made to improve the health and safety of the employees:

1. Continue to use enclosed cabs on heavy equipment.

2. Maintain and change out the air filters on heavy equipment cabs on a scheduled basis.

3. Continue to take steps to control the dust levels to minimize exposure. Dust suppression by applying water onto the farm's dirt roads is an important aspect in this effort.

4. Provide fog-resistant face shields for employees whose work presents a potential for chemical splashes.

5. Should management allow voluntary use of filtering face-piece respirators, it should be done in accordance with OSHA 1910.134, Appendix D (Information for Employees Using Respirators When not Required Under Standard).

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Table 1 Ammonia Sampling Results, Threemile Canyon Farms
August 9-11, 2005

DATE	TIME RANGE	LOCATION (Type of Sample / Task)	METHOD	TWA (ppm)	ONE-MINUTE PEAK (ppm)
08/09	15:04 to 16:20	Lagoon Barge Operator (PBZ / dredging)	Passive diffusion monitor	2	9
08/09	15:04 to 16:19	Deck of Lagoon Barge (area air sample / dredging)	Passive diffusion monitor	8	9
08/09	16:41 to 18:08	Jersey Milk Barn Floater (PBZ / milking operations)	Passive diffusion monitor	2	5
08/09	16:42 to 18:16	Jersey Cow Pusher (PBZ / transfer cows for milking)	Passive diffusion monitor	5	7
08/10	06:47 to 14:55	Lagoon Barge Operator (PBZ / dredging)	Passive diffusion monitor	3	8
08/10	07:22 to 11:43	Holstein Breeder (PBZ / breeding)	Passive diffusion monitor	3	7
08/10	12:02 to 14:46	Holstein Cow Pusher (PBZ / transfer cows for milking)	Passive diffusion monitor	6	9
08/10	08:00	Pin 9 during flushing (1 ft above water) (area air sample)	Detector tube 1	--	3
08/10	08:00	Pin 9 during flushing (1 ft above water) (area air sample)	Detector tube 2	--	2
08/10	08:15	Jersey Milk Barn Footbath (area air sample)	Detector tube	--	Non-detect
08/11	06:39 to 13:44	Lagoon Barge Operator (PBZ / dredging)	Passive diffusion monitor	3	7
08/11	06:54 to 15:26	Middle of Pin 9 (area air sample)	Passive diffusion monitor	4	8
08/11	13:00	Driveway of house nearest to lagoon (area air sample)	Multi-gas detector	--	Non-detect
08/11	13:00	Driveway of house nearest to lagoon (area air sample)	Detector tube	--	Non-detect
NIOSH REL:				**25 (10-hr TWA)**	**35 (15-min STEL)**
OSHA PEL:				**50 (8-hr TWA)**	**--**
ACGIH TLV:				**25 (8-hr TWA)**	**35 (15-min STEL)**

Table 2 Hydrogen Sulfide Sampling Results, Threemile Canyon Farms
August 9-11, 2005

DATE	TIME RANGE	LOCATION (Type of Sample / Task)	METHOD	TWA (ppm)	ONE- MINUTE PEAK (ppm)
08/09	15:00 to 16:19	Lagoon Barge Operator (PBZ / dredging)	Passive diffusion monitor	2	10
08/09	15:03 to 16:19	Deck of Lagoon Barge (area air sample / dredging)	Passive diffusion monitor	1	1
08/09	16:41 to 18:08	Jersey Milk Barn Floater (PBZ / milking operations)	Passive diffusion monitor	1	2
08/09	16:42 to 18:16	Jersey Cow Pusher (PBZ / transfer cows for milking)	Passive diffusion monitor	1	3
08/10	06:47 to 14:55	Lagoon Barge Operator (PBZ / dredging)	Passive diffusion monitor	1	14
08/10	07:23 to 11:43	Holstein Breeder (PBZ / breeding)	Passive diffusion monitor	1	5
08/10	12:02 to 14:46	Holstein Cow Pusher (PBZ / transfer cows for milking)	Passive diffusion monitor	1	1
08/10	08:00	Pin 9 during flushing (1 ft. above water) (area air sample)	Detector tube 1	--	6
08/10	08:00	Pin 9 during flushing (1 ft. above water) (area air sample)	Multi-gas detector	--	4
08/10	08:05	Pin 9 during flushing (at shoulder height several feet from flushing water) (area air sample)	Detector tube 2	--	1
08/10	08:05	Pin 9 during flushing (at shoulder height several feet from flushing water) (area air sample)	Multi-gas detector	--	Non-detect
08/10	08:15	Jersey Milk Barn Footbath (area air sample)	Detector tube	--	Non-detect
08/10	08:15	Jersey Milk Barn Footbath (area air sample)	Multi-gas detector	--	Non-detect
08/10	10:30	Compost Heap (area air sample /mechanical turning)	Detector tube	--	Non-detect
08/10	10:30	Compost Heap (area air sample /mechanical turning)	Multi-gas detector	--	Non-detect
08/11	06:39 to 13:44	Lagoon Barge Operator (PBZ / dredging)	Passive diffusion monitor	1	1
08/11	06:54 to 15:26	Middle of Pin 9 (area air sample)	Passive diffusion monitor	1	2
08/11	13:00	Driveway of house nearest to lagoon (area air sample)	Multi-gas detector	--	Non-detect
08/11	13:00	Driveway of house nearest to lagoon (area air sample)	Detector tube	--	Non-detect
NIOSH REL:					**10 (10-min Ceiling)**
OSHA PEL:					**20 (10-min Ceiling)**
ACGIH TLV:			**10 (8-hr TWA)**		**15 (15-min STEL)**

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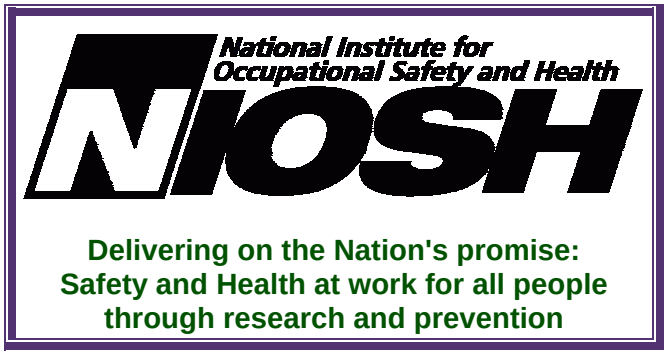

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