

TO: Director, National Institute for Occupational Safety and Health

FROM: Iowa FACE Program

Case No. 2IA61

Report Date: 07/22/03

SUBJECT: Swine Confinement Worker Dies from Carbon Monoxide Poisoning

SUMMARY

On November 27, 2002 a 22-year-old male swine confinement worker was overcome by carbon monoxide gas while in an employee rest/wash/change (ERWC) room that was attached to two large swine confinement buildings. The ERWC room measured 7 feet wide by 17.5 feet long with a 7.5 foot high ceiling. No windows were in the room, but it had two walk-in ingress/egress doors located on opposite sides of the room (see Figure 1). One of these doors led to the outside, and the other to an alleyway between the two confinement buildings. The ERWC room contained a toilet, sink, shower, small shelves, a combination electric clothes washer/dryer unit, hot water heater, and a stationary high-pressure hot-water power washing unit. (see Photo 1).

Just prior to the incident the victim was outside the swine confinement buildings servicing farm equipment. He entered the ERWC room through the outside walk-in entry door, closed the door behind himself and went to use the toilet. The other walk-in entry door from the alleyway between the buildings was closed. In the meantime, a co-worker in another room of the swine buildings connected a spray nozzle and hose to the piping system and began to power wash/clean that area.

After roughly 15 minutes, the co-worker stopped washing and went to the ERWC room to use the rest room facilities. After entering, he noticed that both walk-in entry doors were closed, then saw the victim lying face down on the floor in front of the toilet, with his pants at his ankles. The co-worker immediately turned the victim over and found him unresponsive. He began to administer CPR, but stopped just long enough to open up the room (co-worker felt dizzy and did not want to be overcome himself). After 10 to 15 minutes the co-worker contacted the local emergency response by dialing 911. Within 15 minutes the emergency crew was at the scene, but by this time the carbon monoxide gas had dissipated in the ERWC room. The victim was transported to the local area hospital where he was pronounced dead.



Photo 1 – Side view of LP fired heater unit.

RECOMMENDATIONS based on our investigation are as follows:

- 1. *Employers must ensure that all combustion-powered appliances, equipment and systems are properly installed.*
- 2. *Employers must ensure that all personnel performing installation, removal, operation, and maintenance activities on combustion-powered equipment and systems are properly trained in such function, including hazards that may be produced.*
- 3. *Employers should install, test and maintain a monitoring system designed to measure the concentration of carbon monoxide gas and warn employees of its presence in any enclosed space where combustion-powered appliances, equipment and systems are installed and/or utilized.*
- 4. *Employers must insure that their facilities means of ingress/egress are continually maintained free of obstruction or impediments to full instant use in the case of fire or other emergency.*

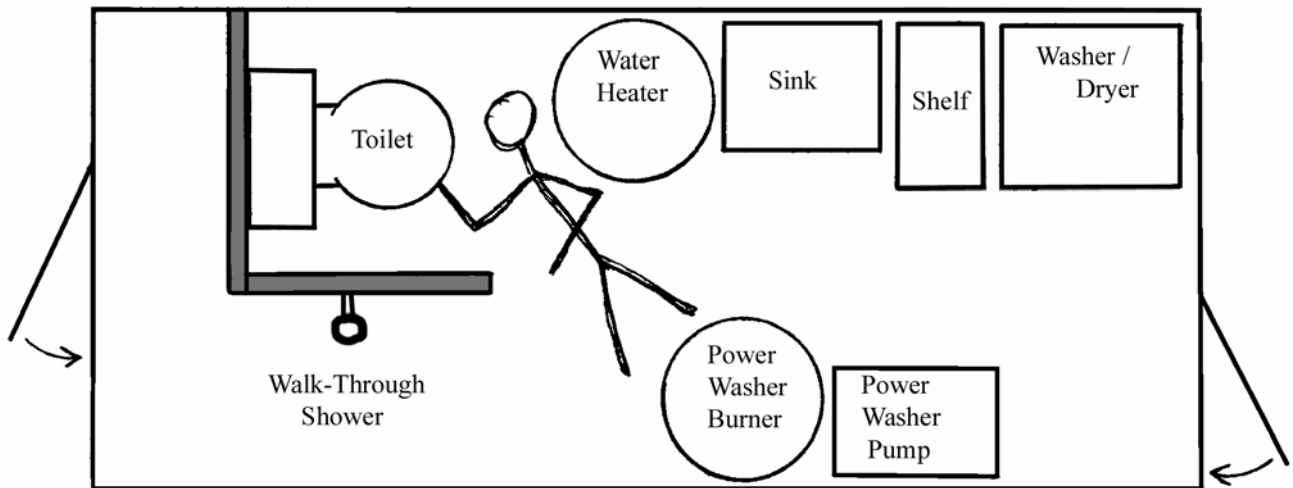


Figure 1: Diagram of Swine Confinement Buildings Employee Rest, Wash and Change Room.

INTRODUCTION

On November 27, 2002 a 22-year-old male swine confinement worker was overcome by carbon monoxide gas while in an employee rest/wash/change (ERWC) room, attached (by an enclosed alleyway) to two large swine confinement buildings. The Iowa FACE investigative team was informed of the incident one month later during a review of press clippings, and immediately began to collect information. Sources of information for this investigation were official reports and photographs from the local Sheriff's Office and State Medical Examiner, along with interviews with a Company representative. Information was also drawn from the citation issued to the Company by the Iowa Division of Labor Services: Occupational Safety and Health Bureau. Unfortunately, due to legal concerns, Company representatives were not willing to discuss any details surrounding this incident, or general work practices and procedures in use at their facilities at the time. Further, Company representatives were unwilling to discuss the contents and methods utilized to deliver the Company's safety and health training programs and procedures to employees.

The Company had one previous fatality at a different swine confinement facility located in Iowa. Approximately two months before this incident, a Company employee was fatally injured while driving a farm tractor that was hitched to and pulling a swine manure transfer hose on a hillside. The manure transfer hose broke, releasing manure under the tractor. This caused the tractor to slip down the hillside and roll over the operator, fatally crushing him. Since this farm tractor pre-dated OSHA regulations requiring Roll-Over Protective Structures (ROPS), no violations were proposed.

The Company builds and operates large swine confinement facilities (i.e. breeding, nursery, and feeding) in several Midwestern states that provide livestock to the meat packing/processing industry. At the time of the incident, the Company owned and operated seven swine confinement facilities similar in size, configuration, and layout as the site where this incident occurred (i.e. power washer units located inside ERWC rooms). By the time the FACE investigation was undertaken, the Company had removed the power washer unit located inside the ERWC room at this facility, and also at other swine facilities that it owned/operated. Consequently, no site visit was made to the facility where this incident occurred.

INVESTIGATION

This swine confinement facility had two large, single story buildings with low sloping roofs that were connected by a central, enclosed alleyway. The ERWC room was attached to one side, at the center, of the central, enclosed alleyway. The buildings and alleyway were constructed with wooden trusses and members and had corrugated steel roofs, interior and exterior siding. These buildings are attached to concrete slab foundations. Automated swine feeding and watering equipment, along with manure handling and storage equipment, was positioned throughout each swine confinement building. Farm tractors and swine feed grinding/mixing equipment were located outside the confinement buildings.

The source of the carbon monoxide was the commercially available stationary high-pressure hot-water burner unit that was located inside the ERWC room. The dimensions of the ERWC room measured 7 feet wide by 17.5 feet long with a 7.5 foot high ceiling. There were no windows in the ERWC room and two walk-in ingress/egress doors located on opposite sides of the ERWC room. One walk-in entry door led to the outside and the other to an alleyway between the two swine confinement buildings. The ERWC room contained the power washer heater and pump assembly, toilet, sink, shower, small shelves, a combination electric clothes washer/dryer unit, and a conventional electric hot water heater. The power washer consisted of a high-pressure electric water pump interconnected to the high flow liquid propane (LP) gas-fired water heater/burner section. Further, the power washer was coupled to a stationary piping system that was run throughout the interior of the swine confinement buildings and designed to provide hot water at a constant temperature and pressure throughout the confinement facility (i.e. demand activated).

In general, the primary work-tasks for the swine confinement workers centered around the day-to-day care and wellbeing of the confined swine. Consequently, the workers inspect, vaccinate, and load swine in and out of confinement buildings, constantly moving in and out of pens. In addition, these workers were charged with inspecting and maintaining the swine feed, water and manure handling equipment. Also, general facility maintenance and cleaning (i.e. power washing) were their responsibility. The degree of physical contact that occurs between swine confinement workers and the swine is dependant upon the size of the animals. Specifically, workers caring for small animals (newborns up to 40 lbs.)

will tend to have a large amount of physical contact with animals (i.e. picking them up, inspecting, vaccinating, etc.). Alternatively, swine confinement workers charged with the care of larger animals (>40 lbs.) will not physically pickup or handle the animals.

Prior to the incident the victim had been working on farm machinery located outside the swine confinement buildings. One other co-worker was present onsite and was working inside one of the confinement buildings. The victim entered the ERWC room through the outside walk-in entry door, closed the door behind himself, and evidently went to use the toilet. The other walk-in entry door from the alleyway between the swine confinement buildings was closed. In the meantime, the co-worker connected a spray nozzle and hose to the stationary piping system inside one of the buildings and began to power wash/clean his work area. After roughly 15 minutes, the co-worker finished washing and proceeded to the ERWC room to use the rest room himself. Upon entering, he noticed that both walk-in entry doors were closed and saw the victim lying face down on the floor in front of the toilet, his pants at his ankles and his underwear partially down.

The co-worker immediately turned the victim over and found him unresponsive. He then began to administer CPR, but stopped after he himself was feeling dizzy. He opened both doors to the room to improve ventilation and then returned to aid the victim. After 10 to 15 minutes the co-worker dialed 911 for assistance, then, resumed administering CPR. Within 15 minutes, the emergency response crew was at the scene. By this time the carbon monoxide gas had dissipated substantially in the ERWC room, however the victim was pronounced dead after transport to the local area hospital.

Second degree burns were found on the victim's back matching the elevation, size and shape of several of the power washer's hot components. Based upon the information obtained during our investigation it appears that the victim tried to leave the ERWC room before being overcome. He most likely noticed something wasn't right, stood up from the toilet, than immediately became dizzy and disoriented due to the carbon monoxide gas. He apparently fell back against the power washer's water heater/burner section, sustained contact first and second degree burns on his back, than fell forward where he was later found. The co-worker who found the victim stated that less than a week earlier, at the site where the incident occurred, over 100 swine had been lost because of a ventilation problem. Further, it was reported that employees that worked in this swine confinement facility had also been suffering breathing difficulties and burning eye sensations, and were aware that the equipment in the ERWC room was venting dangerous gas into the ERWC room.

The power washer's water heater/burner section was installed with an exhaust duct (flue), but no ducting was installed to provide intake air for combustion from outside the ERWC room (see Photo 1), as is required by OSHA [29 CFR 1910.110(b)(20)(iv)(a & b)]. Consequently, the power washer's water heater/burner section was installed in such a way that it could quickly consume and replace the air in the small ERWC room with deadly carbon monoxide gas. Furthermore, the stationary power washer unit was positioned in the ERWC room such that it presented an obstruction to the facilities route of ingress/egress.

CAUSE OF DEATH

The medical examiner listed the cause of death for as, "*carbon monoxide poisoning.*" An autopsy was performed.

RECOMMENDATIONS / DISCUSSION

- **Recommendation #1:** *Employers must ensure that all combustion-powered appliances, equipment and systems are properly installed.*

Discussion: At the time of the incident, the power washer unit's LP gas-fired water heater/burner section was not properly installed with an outside air supply duct as is required by reference under 29 CFR 1910.110 (b)(20)(iv)(a & b). Specifically, the installation was not in accordance with the National Fire Protection Association (NFPA) consensus standards of NFPA 54-1969: Standard for the Installation of Gas Appliances and Gas Piping (incorporated by reference as 29 CFR 1910.6 (q)(10)) or NFPA 54A-1969: Standard for the Installation of Gas Piping and Gas Equipment on Industrial Premises and Certain Other Premises (incorporated by reference as 29 CFR 1910.6 (q)(11)).

There are several critical reasons why an outside air supply duct must be installed on all combustion sources. First, the outside air supply duct insures that air for combustion is drawn only from outside the structure or building envelope. Second, the outside air supply duct prevents the entry of other combustible gases from entering the combustion chamber. Lastly, the outside air supply duct prevents combustion gases (i.e. carbon monoxide, carbon dioxide, etc.) from being back drafted (or emitted) into the structure or buildings envelope. Consequently, had the power washer unit's water heater/burner section been properly installed, it is unlikely the victim would have been overcome by carbon monoxide fumes.

- **Recommendation #2:** *Employers must ensure that all personnel performing installation, removal, operation, and maintenance activities on combustion-powered equipment and systems are properly trained in such function, including hazards that may be produced.*

Discussion: At the time of the incident, the swine confinement workers operating the power washer unit had not been trained relative to the carbon monoxide hazards produced by the power washer unit's LP gas-fired water heater/burner section or methods required to control these hazards (29 CFR 1910.110 (b)(16)). Workers at this confinement facility were aware of air problems in the ERWC room due to the water heater, yet nothing had been done by management to identify and fix the problem. Although several swine were killed one week earlier and workers suffered breathing difficulties, either the workers or management did not appreciate the immediate danger to human life. Proper safety training on the use and maintenance of this equipment may have alerted someone sufficiently to take immediate action

- **Recommendation #3:** *Employers should install, test and maintain a monitoring system designed to measure the concentration of carbon monoxide gas and warn employees of its presence in any enclosed space where combustion-powered appliances, equipment and systems are installed and/or utilized.*

Discussion: At the time of the incident the ERWC room was not equipped with any monitoring system designed to measure the concentration of carbon monoxide gas and warn employees of its presence. Because the ERWC room was an area that employees frequently occupied (to

perform small equipment cleaning, laundry, shower, rest room, etc.) and was an enclosed space (limited means of entry/egress, no windows, no dedicated fresh air ventilation system, etc.) that contained a large stationary combustion-powered appliance (i.e. high flow LP gas-fired water heater/burner section) it is reasonable to conclude that this area should have had a carbon monoxide monitoring system in place. Furthermore, the configuration of the exhaust gas ducting (flue) from the power washer's heater/burner section (see Photo 1) and placement of this appliance in such a "high employee traffic" area increases the probability that such equipment could be disturbed, vent carbon monoxide gas into the enclosed space and present a hazard to anyone entering or occupying the ERWC room.

- **Recommendation #4:** *Employers must insure that their facilities means of egress are continually maintained free of obstruction or impediments to full instant use in the case of fire or other emergency.*

Discussion: At the time of the incident, the stationary power washer unit (high-pressure electric water pump interconnected to a high flow LP gas-fired water heater/burner section) was placed in the route of ingress/egress from the swine confinement facility (see Figure 1). Consequently, employees evacuating this facility under emergency conditions could be injured and/or burned due to the layout design of this ERWC room. This is one aspect of employee health and safety that must be considered during facility design and construction. It is imperative that employers ensure that the means of egress to their facilities be continually maintained free of obstructions or impediments (29 CFR 1910.37 (k)(2)). In addition, the exposed hot components of the power washer's water heater/burner section represented a constant burn hazard for anyone using the ERWC room. Apparently, one had to change clothes while standing up in the middle of the room while at risk of leaning against the power washer's water heater/burner section.

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Fatality Assessment and Control Evaluation

FACE

FACE is an occupational fatality investigation and surveillance program of the *National Institute for Occupational Safety and Health* (NIOSH). In the state of Iowa, *The University of Iowa*, in conjunction with the *Iowa Department of Public Health* carries out the FACE program. The NIOSH head office in Morgantown, West Virginia, carries out an intramural FACE program and funds state-based programs in Alaska, California, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, Oklahoma, Oregon, Washington, West Virginia, and Wisconsin.

The purpose of FACE is to identify all occupational fatalities in the participating states, conduct in-depth investigations on specific types of fatalities, and make recommendations regarding prevention. NIOSH collects this information nationally and publishes reports and Alerts, which are disseminated widely to the involved industries. NIOSH FACE publications are available from the NIOSH Distribution Center (1-800-35NIOSH).

Iowa FACE publishes case reports, one page Warnings, and articles in trade journals. Most of this information is posted on our web site listed below. Copies of the reports and Warnings are available by contacting our offices in Iowa City, IA.

The Iowa FACE team consists of the following from the University of Iowa: Craig Zwerling, MD, PhD, MPH, Principal Investigator; Wayne Johnson, MD, Chief Investigator; John Lundell, MA, Coordinator; Risto Rautiainen, PhD, Co-Investigator, Martin L. Jones, PhD, CIH, CSP, Co-Investigator, and John Kraemer, PA. From the Office of The State Medical Examiner.



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