DATE: January 26, 1999

FROM: Minnesota Fatality Assessment and Control Evaluation (MN FACE) Program Minnesota Department of Health

SUBJECT: MN FACE Investigation 98MN05501
Farmer Dies After Being Engulfed In Corn Inside A Steel Grain Bin

SUMMARY

A 76-year-old male farmer (victim) died after he was engulfed in corn inside a steel bin. On the day of the incident, he used an auger to remove corn from the bin. The bin was equipped with a drying system that included an electric fan to force air into the bin. The fan was not turned on at the time of the incident. The bin had a roof access hatch that was accessible from an exterior ladder attached to the side of the bin. The bin was equipped with an auger tube mounted horizontally within the concrete base of the bin. The bin was being emptied by a portable auger that had been inserted into the auger tube and was running at the time of the incident. Although most of the corn was in good condition, some of it had spoiled due to moisture that apparently entered the bin near the edge of the bin roof. Along a portion of the bin's inside wall, spoiled corn was stuck to the wall and did not collapse as the bin was emptied. The victim climbed the exterior bin ladder and entered the bin, apparently to break up the spoiled corn that was stuck to the wall. The spoiled grain apparently collapsed and engulfed the victim. The victim's wife was working in the farm yard and became concerned when she did not see him in the area of the unloading equipment. She placed a call to emergency personnel who arrived at the scene shortly after being notified. They cut holes in the bin to empty it and discovered the victim. They removed him and transported him to a local hospital where he was pronounced dead. MN FACE investigators concluded that, in order to reduce the likelihood of similar occurrences, the following guidelines should be followed:

- all equipment used to empty a grain bin should be stopped, and the power source locked out, before workers enter the bin.;

- workers should follow confined space entry procedures when entering grain

bins;

- grain bins should be identified as confined spaces and posted with hazard warning signs at all entrances; and

- grain bin ventilation fans should be turned on and operating properly before workers enter bins which are either full or partially full.

INTRODUCTION

On October 6, 1998, MN FACE investigators were notified of a farm work-related fatality that occurred on September 25, 1998. The county sheriff's department was contacted and a releasable copy of their report of the incident was obtained. A site investigation was conducted by a MN FACE investigator on November 20, 1998. During MN FACE investigations, incident information is obtained from a variety of sources such as law enforcement agencies, county coroners and medical examiners, employers, coworkers and family members.

INVESTIGATION

On the day of the incident, the victim used an auger to remove corn from a steel grain bin. The bin was 20 feet in diameter and it's sides were 16 feet high. It had a storage capacity of approximately 4000 bushels. The bin was equipped with a grain drying system that consisted of a propane gas burner and an electric fan to force heated air into the bin. The fan could also be used to aerate the stored grain by forcing air into the space between the concrete bin foundation and a raised steel floor in the bin. The air was forced upward through the stored grain and escaped through seams in the bin roof. The fan was not turned on at the time of the incident.

The bin had four access hatches located around the perimeter of the roof. One of the hatches was accessible from an exterior ladder attached to the side of the bin. The bin had a side access door that was approximately 3 feet wide by 3.5 feet high. The door was fitted with a hinged exterior door that opened outward and with 6-8 overlapping panels that slid into slots along the sides of the door opening. Each panel was 3 feet long and approximately 6 inches wide and prevented stored grain from exerting pressure against the hinged exterior door. The bin was equipped with a 6 inch diameter auger tube mounted horizontally within the concrete base of the bin. It extended from one side of the bin to the center of the bin floor where an intake opening was located. The bin was being emptied at the time of the incident by a portable auger that had been

inserted into the auger tube. The unloading auger was running at the time of the incident.

The steel bin contained approximately 3,000 bushels of corn at the time of the incident. It had been filled approximately a year before the incident with corn that was harvested after the 1997 growing season. Although the majority of the corn was in good condition, some of it had spoiled due to moisture that apparently entered the bin near the edge of the bin roof. Along a portion of the bin's inside wall, spoiled corn was adhered to the wall and did not collapse as the bin was emptied.

The victim climbed the exterior bin ladder and entered the bin through an access hatch, apparently to break up the spoiled corn that was stuck to the side of the bin. While inside the bin, a portion of the spoiled grain apparently collapsed and resulted in the victim being engulfed. The victim's wife was working in the farm yard and became concerned when she noticed that he was not in the area of the equipment being used to empty the bin. She placed a call to emergency personnel who arrived at the scene shortly after they were notified. They cut holes in the sides of the bin to empty it and discovered the victim. They removed him from the bin and transported him to a local hospital where he was pronounced dead.

CAUSE OF DEATH

The cause of death listed on the death certificate was suffocation in corn.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: All equipment used to empty a grain bin should be stopped, and the power source locked out, before workers enter the bin.

Discussion: Workers are exposed to various hazards if they enter or work inside a grain bin while it is being emptied. When grain is flowing from a bin, a worker inside the bin may be quickly engulfed and buried by the flowing grain. Flowing grain acts similarly to quicksand and may create forces so great that once a worker is waist deep in the grain, he or she will be unable to escape even with the aid of a safety rope. Typical auger unloading rates are high enough that a worker may be pulled below the surface of the grain in less than 20 seconds. Because of these hazards, workers should never enter or work inside a bin when it is being emptied. In addition, all power sources should be locked out to ensure that unloading equipment cannot start accidentally or be started inadvertently by someone else. This may require locking out all

electrical circuits that operate electric motors, removing ignition keys from tractors or removing spark plug wires from gasoline engines.

Recommendation #2: Workers should follow established confined space entry procedures when entering grain bins.

Discussion: If entrance into a grain bin is necessary, workers should follow established confined space entry procedures such as those described in NIOSH Publication No. 80-106. Anyone entering a bin should wear a safety belt or harness and a lifeline that is attached to a fixed external anchor point in a manner that ensures they will remain above the surface of the stored material. In addition, a standby person should be stationed outside the bin whenever a worker enters a bin. Visual contact and/or audible communication should be maintained between the worker in the bin and the standby person at all times. Details of a rescue must be discussed and understood by the worker and the standby person before entry into a bin occurs.

Recommendation #3: Grain bins should be identified as confined spaces and posted with hazard warning signs at all entrances.

Discussion: Grain bins meet the NIOSH definition of a confined space. A space is considered "confined" if it has any one of the following characteristics: (1) limited openings for entry and exit; (2) unfavorable natural ventilation; or (3) is not designed for continuous worker occupancy. Entrance into confined spaces are addressed in NIOSH Publication No. 80-106 (Working in Confined Spaces). Warning signs to alert farm workers of the hazards associated with grain bins should be posted at all entrances. In some areas, signs should be printed in more than one language for workers who might not be able to read and understand English.

Recommendation #4: Grain bin ventilation fans should be turned on and operating properly before workers enter bins which are either full or partially full.

Discussion: Older grain bins typically were not equipped with ventilation fans but many grain bins built in recent years are equipped with electric ventilation fans. These fans are used primarily to circulate unheated air through the stored grain. Ventilation fans force outside air into a space between the concrete bin foundation and a raised steel floor containing small holes. The air is forced upward through the grain and escapes through seams in the bin roof. When ventilation fans are operating, they are capable of providing a flow of air through the stored grain. Although this flow of air is small, it may prevent a buried worker from suffocating if the

worker is located within a short time after being buried in the grain. The presence and use of ventilation fans does not lessen or eliminate the confined space hazards of steel bins nor does their use reduce the need for workers to follow the guidelines provided in Recommendations 1, 2, and 3. However, grain bin ventilation fans should be turned on and operating properly before workers enter bins which are either full or partially full.

REFERENCES

1. NIOSH (1979). Criteria For a Recommended Standard: Working in Confined Spaces. Morgantown, WV: U.S. Department of Health, Education, and Welfare, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 80-106.

George Wahl, M.S.
Principal Safety Investigator
MN FACE

David L. Parker, M.D., M.P.H.
Principal Investigator
MN FACE

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