DATE: August 23, 1996

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

SUBJECT: MN FACE Investigation 96MN04701
Farmer Dies After Being Engulfed in Corn Inside A Steel Grain Bin

SUMMARY

A 71-year-old male farmer (victim) suffocated after he was engulfed in corn inside a steel bin. The bin was equipped with an unloading auger mounted between a raised steel floor and the concrete base that supported the bin. It was also equipped with a grain drying unit that included a fan that could be used to aerate the stored grain by circulating air through it. The fan was not turned on at the time of the incident. The victim was removing corn from the bin when he noticed that the flow of corn from the unloading auger was decreasing. He climbed an exterior ladder on the bin to an access opening on the roof of the bin. He entered the bin with a shovel in order to remove corn from the side door of the bin so a sweep auger could be placed in the bin to remove the rest of the corn**.**

When the victim began shoveling, the grain began to flow again and he became immersed up to his shoulders. The victim's brother, who had been mowing grass in the area, noticed that the flow of grain had entirely stopped and climbed to the top of the bin to investigate. The victim's brother attempted to move the corn away from his brother by using the auger. This caused the corn to flow, further burying the victim. The victim's brother made a call to emergency response personnel and then entered the bin himself in an attempt to shovel corn away from the victim. The victim's brother also became immersed in corn up to his shoulders. Emergency response workers were able to rescue the victim's brother by pulling him out of the corn. The emergency response workers then cut holes in the sides of the bin in order to let the corn spill out of the bin. The victim was removed from the bin and transported to a local hospital where he was pronounced dead after resuscitation attempts failed. MN FACE investigators concluded that, in order to reduce the likelihood of similar occurrences, the following guidelines should be followed:

- all equipment used to fill or empty a grain bin should be stopped, and the

power source locked out, before workers enter the bin;

- workers should follow established confined space entry procedures when entering grain bins;

- grain bins should be identified as confined spaces and posted with hazard warning sign 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 June 27, 1996, MN FACE investigators were notified of a farm work-related fatality that occurred on June 26, 1996. 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 MN FACE investigators on July 22, 1996. 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 removed corn from a steel grain drying and storage bin. The 22-year-old bin was 27 feet in diameter and 16 feet high. It had a storage capacity of 8,000 bushels and contained approximately 4,000 bushels of corn at the time of the incident. The bin was equipped with a drying unit that could be used independently as a ventilation fan. The ventilation fan, when operated, aerated the stored grain by forcing outside air into the space between the concrete bin foundation and the raised steel floor. The air was forced upward through the stored grain and escaped through seams in the bin roof. The ventilation fan was not turned on at the time of the incident. The bin had several access hatches located near the edge of the roof and evenly spaced around it's perimeter. The bin also had a side access door that was approximately 3 feet wide by 3 and one-half feet high. The bottom of the side door was approximately 18 inches above the bin floor. 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. Each panel was 3 feet long and 6 inches wide and when in place, prevented stored grain from exerting pressure against the hinged exterior door. Grain could be emptied from the bin by sliding the individual panels upward. The bin was equipped with a 6 inch diameter unloading auger mounted horizontally below the raised

steel floor of the bin. It extended from one side of the bin to the center of the bin floor where a square auger intake opening was located.
The victim was removing corn from the bin when he noticed that the flow of corn from the unloading auger was decreasing. He went to check on the reason for the decreased grain flow by climbing an exterior bin ladder to an access opening in the roof of the bin. He entered the bin with a shovel in an attempt to get the grain away from the door on the side of the bin so a sweep auger could be used to continue unloading the grain.

The victim's brother, who had been mowing in a nearby area, noticed that the flow of grain had stopped. He climbed to the top of the bin and saw that the victim was buried up to his chin in corn. The victim's brother left the auger on in an attempt to decrease the level of grain in the bin and prevent his brother from becoming immersed. With the auger on, more grain continued to flow and the victim became further immersed. The victim's brother then got a wooden plank that he placed in the bin in order to be able to position himself near the victim without endangering himself. The victim's brother then placed a cardboard box over the victim's head in an attempt to keep the corn away from his face so he could continue to breath. He then made a call to emergency rescue personnel who arrived at the scene shortly after they were notified. After making the call, the victim's brother re-entered the bin and also became immersed up to his shoulders in grain. Four men from the rescue squad pulled the victim's brother from the bin. The rescue squad then cut into the sides of the bin to remove the grain. The victim was removed from the bin approximately 25 minutes after their arrival and transported to a local hospital where he was pronounced dead after resuscitation attempts failed.

CAUSE OF DEATH

The cause of death given by the victim's physician was suffocation in corn.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: All equipment used to fill or 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 the bin is being filled or emptied. The lack of adequate ventilation inside a bin usually results in high concentrations of dusts as a bin is being filled. Workers not wearing adequate dust masks or respirators will be exposed to these dusts. Exposure to these dusts may have both short- and long-

term hazardous health effects.

In addition, a worker inside a bin that is being filled is at risk of being buried alive by the incoming grain. Even greater dangers may exist when a bin is being emptied. When grain flows from the bottom of 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 after a worker is waist deep in the grain, he or she will not be able to escape, even with the aid of a safety rope. Typical auger unloading rates are high enough that a worker will be pulled below the surface of the grain in less than thirty seconds. Because of these hazards, workers should never enter or work inside a bin when it is being filled or emptied. In addition, all power sources should be locked out to ensure that the loading and/or 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. If the auger system involved in this incident had been stopped and the electric motor circuits had been locked out, this fatality might have been prevented.

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 which is attached to a fixed external anchor point. 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. If established confined space entry procedures and had been followed in this case, this fatality might have been prevented.

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 continuous 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 guideline provided in Recommendation 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 (April 28, 1993). NIOSH Update: NIOSH Warns Farmers of Deadly Risk of Grain Suffocation. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 93-116.