DATE: October 16, 1995

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

SUBJECT: MN FACE Investigation 95MN04501
Farm Youth Dies After Being Engulfed In Corn Inside A Steel Grain Bin

SUMMARY

A 13-year-old male farm youth (victim) died of injuries sustained after he was engulfed in corn inside a steel grain bin. The bin had an oval door on one side that was fitted with both an interior door that opened into the bin and an exterior door that opened to the outside. The interior door had a square discharge opening that was used to allow corn to flow from the bin when it was being emptied. A steel ladder was fastened to the side of the bin and provided access to an opening in the bin roof that was located along the side of a steel ladder fastened to the bin roof. The victim and his father used a portable auger to remove corn from the bin. A semi-truck was parked beneath the discharge end of the auger.

The victim's father started the auger, opened the small discharge opening and began to remove corn from the steel bin. The victim climbed the steel bin ladder and opened the cover to the roof opening. He remained seated on the roof ladder and observed the corn being removed from the bin. About fifteen minutes after they began unloading the bin, the victim's father walked to the truck and drove it forward so the rest of the truck box could be filled. When he exited the truck, he noticed that his son was no longer sitting on the bin roof ladder. He climbed the bin ladder but could not see his son when he looked into the bin. He returned to the ground and saw a tennis shoe come out of the small discharge opening. He stopped the auger but was unable to open the interior bin door due to the force exerted against it by the corn. He used a tractor equipped with a front end loader to attempt to puncture the bin but the loader broke when it struck the bin. He ran to the farm house and placed a call to emergency personnel. Emergency personnel arrived shortly after being notified and used power saws to cut several holes in the sides of the bin. The victim was removed from the bin and transported to a local hospital. Later he was air lifted to a major medical center where he died two days later. MN FACE

investigators concluded that, in order to reduce the likelihood of similar occurrences, the following guidelines should be followed:

- workers should not position themselves near grain bin access openings while a bin is being filled or emptied;
- workers should follow established confined space entry procedures when entering grain bins; and

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

INTRODUCTION

On August 23, 1995, MN FACE investigators were notified of a farm work-related fatality which occurred on July 11, 1995. The county sheriff's department was contacted and releasable information obtained. Information obtained included a copy of their report of the incident and copies of their photos taken at the incident site. A site investigation was conducted by a MN FACE investigator on September 11, 1995.

INVESTIGATION

On the day of the incident, the victim and his father were removing corn from a steel grain bin. The bin diameter was 16 feet and the sides of the bin were 16 feet high. It had a storage capacity of approximately 2,500 bushels. The bin was not equipped with either an unloading auger in the bin floor or with a ventilation fan to circulate air through the stored grain. The bin had an oval door on one side that was 27 inches wide by 54 inches high. It was fitted with both an interior door that opened into the bin and an exterior door that opened to the outside. When the bin was filled with grain, the interior door could not be opened because of the force exerted against it by the stored grain. The interior door had a 9.5 inch square discharge opening that was used to allow corn to flow from the bin when it was being emptied. A steel ladder was fastened to the side of the bin and provided access to an opening in the bin roof. The roof opening was located near the edge of the bin roof and along the side of a steel ladder fastened to the bin roof. The tapered roof opening was 42 inches long and varied in width from 14 inches at the bottom to 6 inches at the top. It was fitted with a hinged cover that opened to the outside of the bin.

On the morning of the incident, the bin, one of four bins at the incident site (See Figure 1) was

full of corn. The corn did not have a surface crust, e.g. there were no hidden pockets underlying the surface layer. A portable auger powered by an electric motor was positioned in front of the bin. The auger intake was directly below the small square discharge opening in the interior bin door. A semi-truck was parked beneath the discharge end of the auger. The truck was positioned so the auger filled the front end of the truck box. The victim's father started the auger, opened the small discharge opening in the oval bin door and began to remove corn from the bin. The victim climbed the steel bin ladder and opened the cover to the roof opening. He remained seated on the roof ladder and observed the corn being removed from the bin. He did not take any equipment, such as a shovel, to the bin roof with the intent of entering the bin. He had been told by his father, on various occasions when they unloaded grain bins, not to enter a bin while it was being emptied.

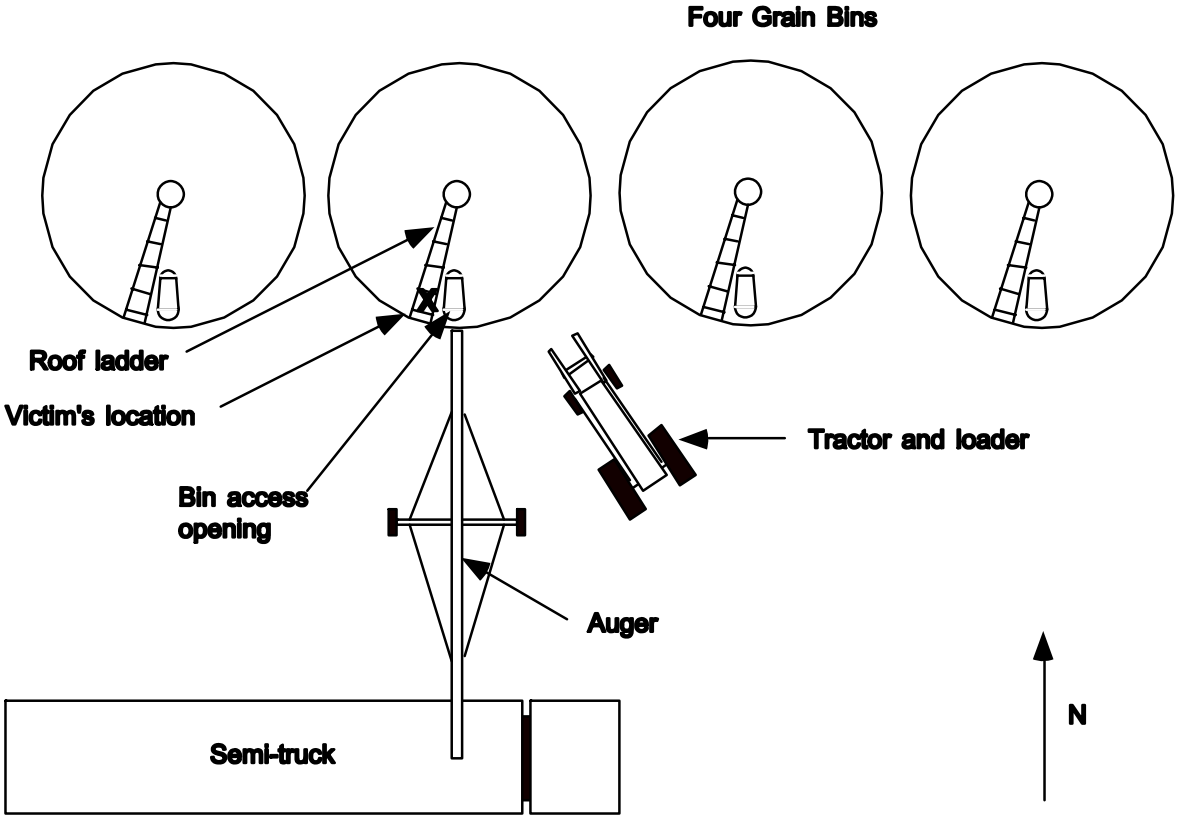

Figure 1. Grain Bin Incident Site - Aerial View
Not To Scale

About fifteen minutes after they began unloading the bin, the front of the semi-truck was full and contained approximately 200 bushels of corn. The victim's father, who had been near the base of the bin, walked to the truck to drive it forward so the rest of the truck box could be filled. When he exited the truck after driving it forward, he noticed that his son was no longer sitting on the bin roof ladder. He climbed the bin ladder but he could not see his son when he looked into the bin through the roof opening. He returned to the ground and saw a tennis shoe come out of the small discharge opening. He stopped the auger but was unable to open the interior bin door due to the force exerted against it by the corn. He then used a tractor equipped with a front end loader to attempt to puncture the bin. The loader,which did not have a bucket or any other attachment on it, broke when it struck the bin and he was unable to release any of the corn. He ran to the farm house and placed a call to emergency rescue personnel. Emergency personnel arrived shortly after being notified and used power saws to cut several holes in the sides of the bin to remove the corn. The victim was removed from the bin and transported to a local hospital. Later he was air lifted to a major medical center where he died two days later.

CAUSE OF DEATH

The cause of death listed on the death certificate was complications of anoxic encephalopathy.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Workers should not position themselves near grain bin access openings while a bin is being filled or emptied.

Discussion: Workers may fall into grain bins whenever they climb to uncovered access openings in the bin roof. If a worker near an access opening accidentally falls into a bin while it is being filled or emptied, they will be exposed to a number of hazards.

- First, 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.

- Second, a worker inside a bin that is being filled is at risk of being buried and suffocated by the incoming grain. Even greater dangers of suffocation may exist when a bin is being emptied. When grain is allowed to flow 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 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 will be pulled below the surface of the grain in less than one minute.

Because of these hazards, workers should never enter, work inside nor position themselves near access openings of a bin while it is being filled or emptied. Whenever any of these activities are done, 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.

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

Discussion: If entrance to a grain bin is necessary, workers should follow established confined space entry procedures such as those described in NIOSH Publications No. 80-106 (Working in Confined Spaces). 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.

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. 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.

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.

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