

INCIDENT HIGHLIGHTS



DATE:
August 4, 2020



TIME:
9:00 p.m.



VICTIM:
11-year-old boy from a Mennonite farm family



INDUSTRY/NAICS CODE:
Beef Cattle Farm/112111



EMPLOYER:
Family farm



SAFETY & TRAINING:
Attended safety sessions in schoolhouse



LOCATION:
New York



EVENT TYPE:
Contact injury: Caught in



REPORT#: 20NY025

REPORT DATE: 8/5/22

Farm youth killed when caught in sweep auger inside a silo at family farm —New York

SUMMARY

On August 4, 2020, at approximately 9:00 p.m., an 11-year-old youth from a Mennonite farm family was fatally injured while cleaning corn off a silo floor. The silo is 50 feet in height and 14 feet in diameter and has a bottom unloader (Photo 1). The sweep auger of the unloader circles the silo floor, moving corn towards a center hopper and the exit auger located underneath the silo floor... [READ THE FULL REPORT](#)> (p.3)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Lockout/Tagout procedures were not followed
- Standard Lockout/Tagout procedures did not exist
- Occupant, the decedent youth, was in the silo with the sweep auger rotating and circling around the silo ...

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RECOMMENDATIONS

New York FACE investigators concluded that, to help prevent similar occurrences, farm owners should:

- Ensure that no one enters a silo unless the power to the sweep auger is turned off and locked out.
- Deploy engineering controls to prevent workers from contacting energized sweep augers.
- implement a safe silo/grain bin entry procedure to eliminate confined space hazards and ensure entrants' safety...

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NEW YORK

State **FACE** Program

Fatality Assessment & Control Evaluation

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The New York State Fatality Assessment and Control Evaluation (NY FACE) is a research program funded by the National Institute for Occupational Safety and Health and administered by the New York State Department of Health. NY FACE collects information on work-related fatalities, investigates the incidents to identify the causes and contributing factors, proposes prevention measures, and shares the injury prevention information with employers, workers, and other organizations interested in promoting workplace safety. NY FACE does not determine fault or legal liability associated with a fatal incident. Names of employers, victims and/or witnesses are kept confidential. Additional information regarding the NY FACE program can be obtained from:

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SUMMARY

On August 4, 2020, at approximately 9:00 p.m., an 11-year-old youth from a Mennonite farm family was fatally injured while cleaning corn off a silo floor. The silo is 50 feet in height and 14 feet in diameter and has a bottom unloader (Photo 1). The sweep auger of the unloader circles the silo floor, moving corn towards a center hopper and the exit auger located underneath the silo floor. The exit auger transports and deposits the corn to a collection container outside the silo. At the time of the incident, there were approximately eight inches of corn on the silo floor. The decedent went inside the silo alone and proceeded to shovel and move the corn towards the center area of the silo and into the hopper. The sweep auger had been left on to aid in the removal of corn. It was rotating and circling while the decedent was inside shoveling. The decedent finished cleaning out one side of the silo and was proceeding to clean the other side. At approximately 9:00 p.m., minutes after the father last saw his son, the father discovered that the decedent was caught by the sweep auger. It appeared that the tip of the sweep auger, which is approximately 10 to 12 inches from the silo wall, caught the decedent's pant leg. The father immediately shut off the unloader and called 911. Even though the emergency responders arrived at the scene quickly, they were unable to save the youth. He was pronounced dead at the scene by the coroner at 9:25 p.m. The cause of death was due to multiple crushing injuries.



Photo 1. An 11-year-old farm youth was fatally injured by a sweep auger inside the silo that is in the foreground.



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INTRODUCTION

On August 4, 2020, at approximately 9:00 p.m., an 11-year-old youth from a Mennonite farm family was fatally injured while cleaning corn off a silo floor. He was caught by the sweep auger of a bottom silo unloader. The New York State Fatality Assessment and Control Evaluation (NY FACE) staff learned of the incident from news media reports. The New York Center for Agricultural Medicine and Health (NYCAMH)/Northeast Center for Occupational Health and Safety (NEC) assisted NY FACE to set up a site visit with the family. A Mennonite community leader was instrumental in arranging for the visit to occur. In July 2021, NY FACE investigators visited the family farm accompanied by NYCAMH/NEC staff and the community leader. During the site visit the investigators observed the silo and the unloader from outside and took pictures of the scene. The decedent's father, who is the owner of the family farm, provided information related to the incident and the family farm operation. The NY FACE investigators reviewed the silo unloader manual and researched the technical information regarding silo technology and silo safety measures. This report summarizes the findings of the NY FACE investigation.

The Occupational Safety and Health Administration (OSHA) did not investigate the case since the decedent was not an employee. Immediate family members of farm owners are not within OSHA's jurisdiction.

FAMILY FARM

The family farm was purchased by the parents of the decedent in 2005. They built a house, barn, and various other outbuildings since its purchase. The farm is composed of seventy acres, with forty-eight of those tillable. The family also leases land on the neighboring property where they grow hay, alfalfa, corn, and soybeans. Additionally, the family grows vegetables. The farm currently has 100 head of young beef cattle as well as a few pigs. The farm is run by the father with the help of his wife, children, and brothers. The children of the family began assisting with family chores and farm work at an early age. The farm does not employ hired help.

COMMUNITY BACKGROUND and FARM SAFETY EDUCATION

The Mennonite community where the incident occurred has approximately 700 families, 11 churches, and 40 schoolhouses. Most families operate small dairy farms with no hired help. All farm work is done by family members including children who start helping with family chores and farm work at an early age. Approximately 75 to 80% of school age children live on farms in this community. The remaining students who do not live on farms often visit farms owned by their relatives or neighbors. Therefore, the whole school age population is potentially exposed to agricultural hazards; incidents of serious injuries including death have occurred.

In responding to community concerns about the safety of the children who work on family farms, the community leader and three other members of the community formed a Farm Safety Committee in 2008. The Committee, in collaboration with NYCAMH/NEC, launched a schoolhouse farm safety training program for school age children. The curriculum covered a variety of typical and common hazards found on most family farms along with protective and prevention measures. The Committee also constructed a farm safety hazard display board which is a miniature operating farm with demonstrations of typical safety hazards for children to learn and identify. The Committee members conduct the training sessions in all schoolhouses. Most school-age children in the community have attended the training sessions since the program's inception.



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The members of the community have no access to the internet or e-mail since they do not own cell phones nor computers. They receive most of the safety information and training through attending community events. Farm Safety Day for Families is a biannual community event. It is organized by the Farm Safety Committee and is typically held in August with the collaboration of the local fire department. The event, which is widely attended by community members, has hosted demonstrations and seminars on varied topics ranging from tractor safety, skid steer safety, general machinery use, safe animal handling techniques, and general silo hazards. To note, many of the family farms in this community have silos and silo unloaders.

The Farm Safety Committee also hosts evening sessions called “Farm Safety for Families” every other winter. Each session attracts anywhere from 100 to 150 attendees.

The local fire department is actively involved in community farm safety and health education. It has a grain bin rescue team that is trained and fully equipped with a grain rescue tube and other appropriate equipment for rescues in grain bins. Firefighters attend community events to demonstrate rescue techniques, equipment, and general farm safety information.

FARM YOUTH DECEDENT

The 11-year-old decedent had been working on the family farm since an early age. Since he was the eldest son, he became his father’s main help for farm work. The other siblings assisted with household chores and light farm work with the mother. In addition to receiving instructions from their parents, the 11-year-old and his school age siblings had also attended the schoolhouse farm safety sessions at their schoolhouse conducted by the Farm Safety Committee and other community farm safety events.

MACHINERY INVOLVED IN THE INCIDENT AND RELATED SAFETY REGULATIONS

The father purchased the silo with the bottom unloader used from a dealer in 2016. The unloader manual came with the purchase, but the silo manual did not. The father erected the silo and installed the unloader with the help of his brother.

The silo, 14 feet in diameter and 50 feet in height, is an oxygen limiting type. When sealed, the interior silo is an oxygen deficient environment which reduces excess fermentation and oxidation and improves the quality of the feed. The unloader is powered by a 3-horsepower 208V-electric motor and a pulley which form the drive unit (Photo 2). A sweep auger, which is mounted on a gearbox in the center of the silo floor, circles the silo moving the stored material towards center and into a hopper underneath the gearbox (Figure 1). There are paddles inside the hopper that assist in moving the collected material into an exit auger located underneath the silo floor. The exit auger is encased in a steel tube and directly driven by the motor through a pulley. It transports the grain and deposits it in a collection container outside the silo.

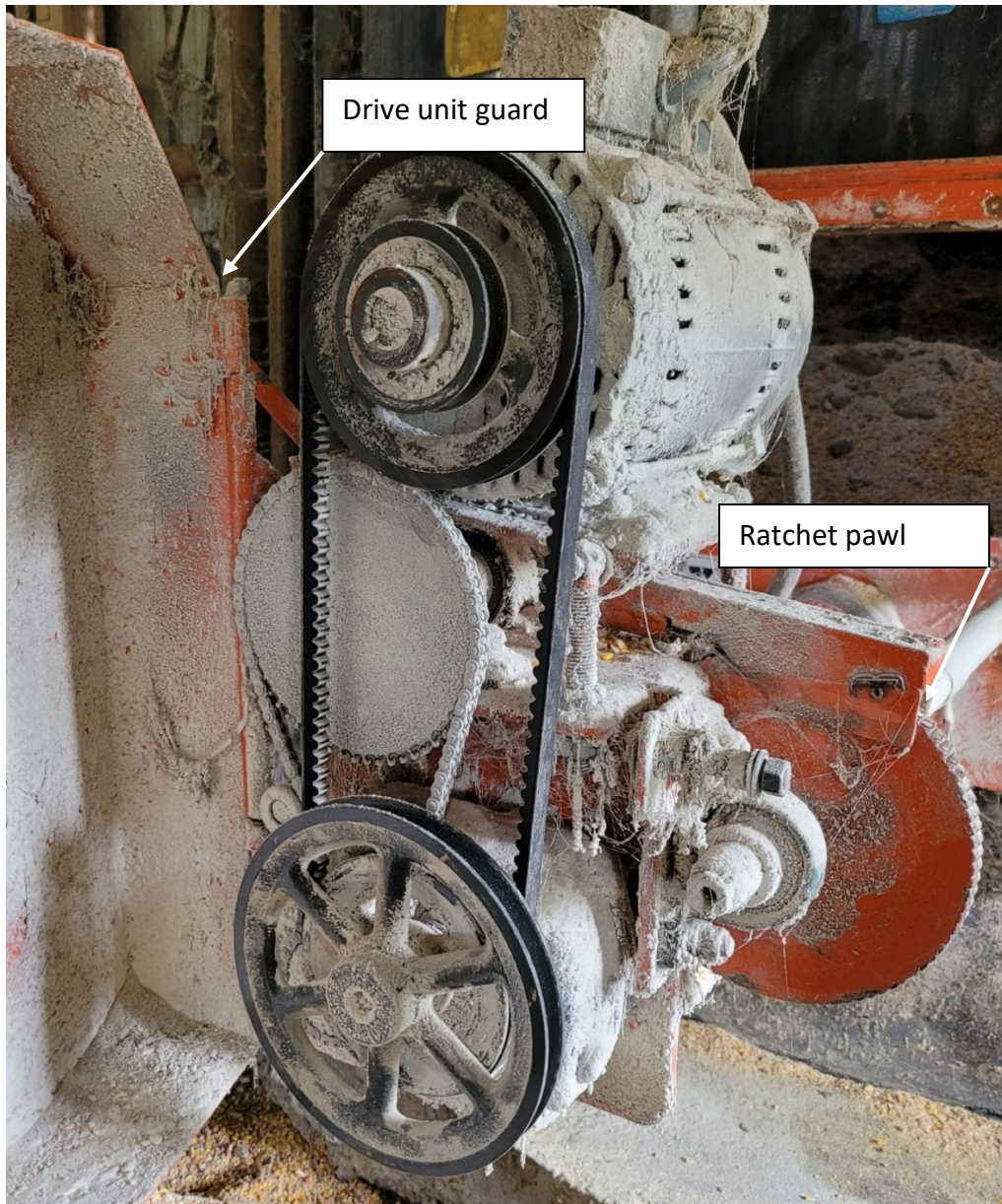


Photo 2. The unloader drive unit that has an electric motor (3 horsepower 208v) and a pulley. It also has a ratchet mechanism that drives the sweep auger drive shaft.

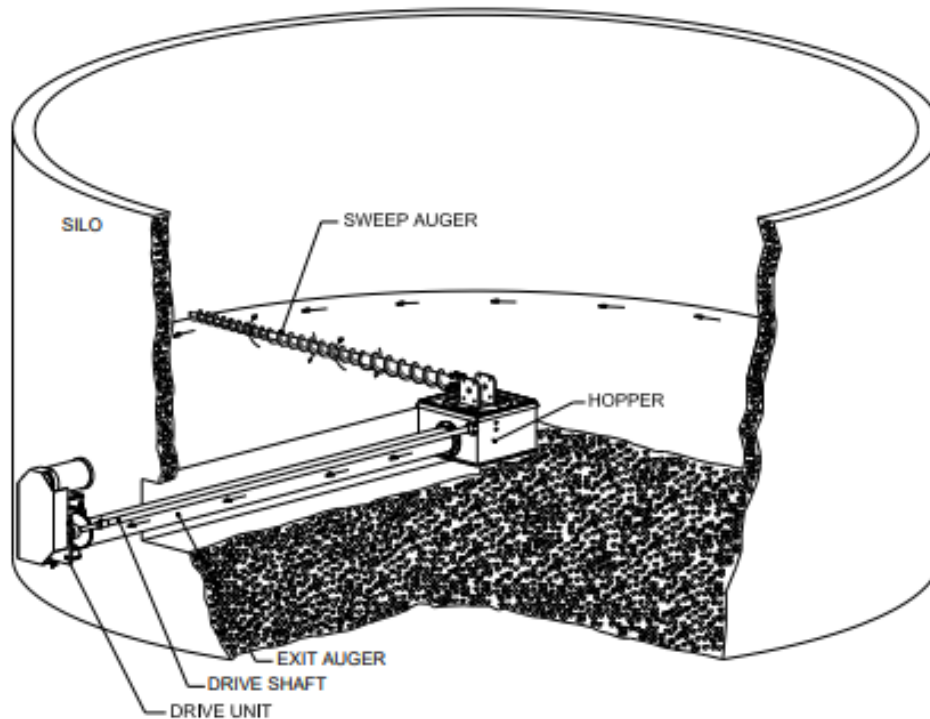


Figure 1. Main components of the bottom silo unloader (Valmetal Owner's Manual).

The sweep auger, which is mounted 8 inches above the silo floor and not guarded, is approximately 56 inches long. The diameter of the sweep auger tapers from 5 inches at the gearbox end to 3 inches at the periphery with approximately 10-12 inches of clearance to the silo wall (Photo 3). To move the stored material towards the hopper, the sweep auger rotates around its center shaft and circles the silo circumference counter clockwise. The sweep auger was observed circling the silo floor at a slow speed. The exact speed was not available in the silo manual. According to the father, there are protruding objects on the sweep auger. The investigators were not able to get inside the silo to examine the number, shape, and location of the protruding objects on the sweep auger.

A ratcheting gear mechanism drives the sweep auger drive shaft (Figure 2) which circles the silo floor. The ratchet pawl spring tension, which is preset, dictates the maximum resistance/torque that the sweep auger can overcome. The manufacturer requires setting the ratchet pawl spring tension to allow the sweep auger to overcome a maximum torque of 125 pounds per foot length (The exact preset ratchet pawl spring tension was not available in this case). Once the sweep auger encounters a resistance that equals or exceeds the maximum torque, the ratchet wheel will stop turning, and the sweep auger will stop circling the silo. There is no mechanism to stop the sweep auger's axial rotation in responding to an obstruction.

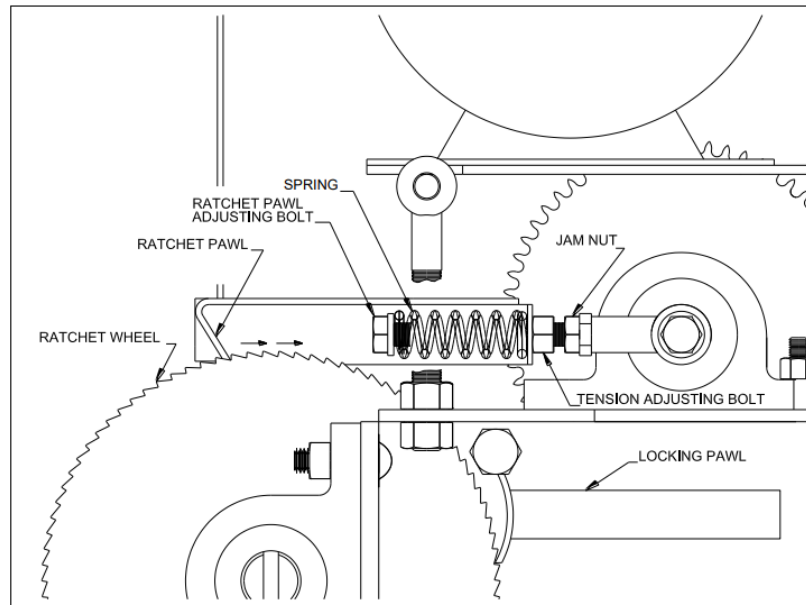


Figure 2. The ratcheting gear mechanism that drives the sweep auger drive shaft (Valmetal Owner's Manual).



Photo 3. The unguarded sweep auger was mounted in the gearbox 8 inches above the silo floor (Courtesy of NYCAMH/NEC).

The controls and emergency shutoff devices for the unloader were located on a nearby wall, approximately 20 feet away from the drive unit (Photo 4). The manufacturer required disconnecting and locking out of the power at main disconnect before working on or near the unloader. The following warnings and requirements are in the owner’s manual: “Lock out power at main disconnect before working near equipment”, “When in operation, no one is permitted in the silo or within falling distance from all moving parts”, and “Do not allow anyone near the machine before or while the unloader is running” (Photo 5).

According to OSHA, a silo is a permit required confined space. OSHA allows a worker to be physically inside a bin/silo with an energized sweep auger provided: 1) The sweep auger is properly guarded at both the top and back areas (The only unguarded portion of the sweep auger should be the front point of operation); 2) The sub-floor auger (exit auger) is guarded by secure grates; 3) Acceptable engineering controls (such as a standard guardrail attached to the auger, a portable guard rail trailing seven feet behind the auger, or a dead-man switch on an operating control inside an enclosure or attached to a handle that keeps the employee seven feet back from the auger) are in place; and 4) The permit required confined space entry procedures are followed.

Unless all safe-entry practices are followed, no one should be inside a silo when the sweep auger is energized. The National Grain and Feed Association (NGFA) outlined the best industry practice in its “Guidance for Sweep Auger Operations in Grain Bins” which incorporated the OSHA requirements. Family farms without employees like the one involved in the incident are exempt from OSHA regulations.



Photo 4. Unloader controls and emergency shutoff devices.



Photo 5. The warning sign on the silo hatch door requires that all operators disconnect the main power source before working near the unloader (Courtesy of NYCAMH/NEC).

INVESTIGATION

The oxygen limiting silo involved in the incident is used to store high moisture ear corn. The silo gets emptied and refilled once a year in late June or early July. After the silo is emptied by the unloader, there is corn left underneath the sweep auger and around the silo wall. Before the silo can be refilled with new feed, a person must enter the silo to manually move the remaining corn to the center hopper so that it can be transported out by the exit auger.

Manual cleaning of corn left on the silo floor is a routine task that has been done at this farm every year. Entry to the silo is through an access door located at the base of the silo. The access door/opening is 15.5 inches in height, 24 inches in width, and 36 inches off the ground (Photo 6). The father did not have a gas monitor to test the silo air. He used a silo blower to ventilate the silo before entry. While inside, he never turned off the power to the unloader since the sweep auger appeared circling the silo in a slow speed, and he needed the exit auger to transport corn out. He worked alone most of the time, and it was inconvenient, difficult, and time consuming to go in and out through the access door to turn the power on and off.



Photo 6. Access door in the base of the silo.

On the evening of the incident, the family including the decedent was busy performing various tasks around the farm. The silo had been emptied for the season a few days before. It was ventilated with the access door removed. The decedent was instructed to clean the corn off the silo floor. The child had performed the tasks several times under his father's supervision. The father had instructed him to stay clear from the sweep auger.

There were approximately eight inches of corn on the silo floor. The silo floor is flat concrete. The decedent went inside the silo alone and proceeded to shovel and move the corn towards the center area of the silo and into the unloader hopper. The sweep auger had been left on to aid in the removal of corn, so it was rotating and circling while the decedent was inside shoveling. Visibility was poor at the time of the incident. There was no artificial lighting inside the silo. The silo interior was only illuminated by a small amount of natural light that entered through the roof fill door and the access door/opening in the base of the silo.

The decedent finished cleaning out one side of the silo and was getting ready to clean the other side. At approximately 9:00 p.m., minutes after the father last saw his son, he discovered that the decedent was caught by the sweep auger. It appeared that the tip of the sweep auger caught the decedent's pant leg. The father immediately shut off the unloader and called 911. The emergency responders arrived at the scene quickly. However, they were unable to save the youth. He was pronounced dead at the scene by the coroner at 9:25 p.m. due to multiple crushing injuries.

CAUSE OF DEATH

According to the death certificate, the decedent died as a result of multiple crush injuries to his head, trunk and extremities.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events. The NY FACE investigation identified the following key contributing factors in this incident:

- Lockout/Tagout procedures were not followed. Power to the silo unloader was left on, which provides power and drive to the sweep auger.
- Standard Lockout/Tagout procedures detailing how to lock out the unloader before entering silo for cleaning or maintenance tasks did not exist.
- Occupant, the decedent youth, was in the silo with the sweep auger rotating and circling around the silo.
- The sweep auger was not guarded.
- The protruding objects on the sweep auger increased the risk of entanglement.
- The lighting inside the silo was inadequate.
- The occupant, the decedent youth, was in the silo alone with no attendant outside to aid or rescue.
- The decedent youth, who was assigned to work in an environment with high risk of entanglement, may have lacked the maturity to understand the nature of the risk due to his age.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Farm owners should ensure that no one enters a silo unless the power to the sweep auger is turned off and locked out.

Discussion: Many fatalities, amputations, and other serious injuries have resulted from workers entering silos or grain bins without deenergizing sweep augers. Most often, these occur when a worker's clothing, shoestrings, or body parts become entangled in the rotating screw of the auger. The silo floor in this case was covered with uneven corn, the lighting was inadequate inside the silo, and there were protruding objects on the sweep auger. All of these subject workers to slip and fall hazards and further increase their risk of being caught and entangled by the rotating sweep auger. The manufacturer in this case specifically requires users to disconnect and lockout the power at the main disconnect before entering the silo.

Farm owners should ensure that all machines including the sweep auger inside a silo are deenergized, locked, and tagged before allowing anyone to enter the silo to work. In this scenario, the reason for allowing the decedent to enter the silo without turning the unloader off was to allow the exit auger, which is under the silo floor, to transport the corn out. This practice could be safely augmented by first turning off the unloader. A worker only enters the silo to sweep after the unloader is turned off. Once corn is swept to the center of the silo, the worker should exit the silo to turn the power back on so that the exit auger can transport the corn out. Technologies described in Recommendation #2 can also be utilized. Some of these technologies allow workers to remove grain safely without having to enter the silo or use equipment which are less hazardous than sweep auger.



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Recommendation #2: Farm owners should deploy engineering controls to prevent workers from contacting energized sweep augers.

Discussion: The silo unloader in this case was not equipped with technologies that would prevent accidental contact with the energized sweep auger. Many modern commercially available unloaders utilize guards around the top, rear, and tip of the sweep auger to prevent a worker from contacting the energized auger accidentally.

Sweep augers can also be outfitted with Sweep Auger Safety Handles, or SASHs. These devices create distance between the worker and the sweep auger, allowing the worker to safely manipulate a sweep auger without having to touch the actual auger or any guarding attached to the auger. These handles can be equipped with electronic switches mounted to a lever that the worker pulls down in order to actuate the auger, but also stops the auger if the lever becomes disengaged. This technology is like dead-man switches on lawnmowers, which stop the lawnmower if the user releases the lever mounted to the handle of the mower.

There are also unloaders that come with zero clearance sweep augers. Zero-clearance sweep augers are augers that do not have a substantial gap between the floor and walls of the silo and the auger, allowing the sweep auger to remove most if not all grain from a silo floor. Not only does this prevent workers from having to enter a silo while the sweep auger is engaged, but it increases efficiency by not having to rely on manual sweeping. There are scenarios where the type of grain being stored or the design of the silo and unloader does not allow for a zero-clearance sweep auger, but it should be included as a reasonable alternative to elevated sweep augers.

Grain vacuums are being used by many commercial storage facilities as well as family farms as an alternative to manual removal of stored material. Numerous fatal injuries occurred in which users or rescuers were trapped and engulfed by the free-flowing stored material while using grain vacuums. To reduce the risk of entrapment and engulfment, family farm owners could choose grain vacuums that have an intake control mechanism which can be used to turn off the vacuum in the event of an emergency to stop or diminish the flow of grain. A grain vacuum would have been useful in this case, as there was only eight inches of corn on the floor of the silo, limiting the chance of engulfment by a grain vacuum operator. Farm owners should ensure that operators are trained in safe methods for using a grain vacuum, provide operators with appropriate personal protective equipment (dust mask, respirator, hearing protection, etc.), and monitor the environment during grain vacuum use to ensure dust, mold spores, or other potentially airborne hazards are mitigated.

Recommendation #3: Farm owners should implement a safe silo/grain bin entry procedure to eliminate confined space hazards and ensure entrants' safety.

Discussion: Approximately 134 U.S. workers died from silo related incidents between 2011 and 2019 according to the U.S. Bureau of Labor Statistics Census of Occupational Fatal Injuries. These workers were killed by falls, electrocution, engulfment, oxygen deficiency, and contact with energized machinery. Storage structures such as silos or grain bins are permit required confined spaces by OSHA definition. A confined space is a space that is not designed for continuous human occupancy and large enough for a person to enter and has limited means of entry or exit. Permit required confined spaces have the potential to have a hazardous atmosphere, energized equipment, or the potential and capacity to trap, engulf, or asphyxiate an entrant.

OSHA requires that employers develop specific procedures to be followed prior to allowing workers to enter or work in a permit-required confined space. The safe entry procedure at the minimum should:

- Ensure that the atmosphere contains a safe level of oxygen and is free of gases and particles that can pose an immediate danger to life and health,
- Identify and control hazards associated with unstable surfaces,
- Identify and control other hazards, such as mechanical or electrical hazards,
- Train employees in permit-required confined space entry, testing, and the use of personal protective equipment including safety harnesses, respirators, clothing, etc.,
- Station a stand-by person outside the space for communication and visual monitoring, and
- Summon and provide emergency rescue.

The silo in this case is an oxygen limiting type which has all the openings sealed to prevent oxygen from entering. Silo gases (carbon dioxide and nitrogen dioxide) generated during fermentation can cause permanent lung damage and death and reduce the oxygen inside the silo to a level that is too low to support human life (<19.5%). Family farm owners should follow the proper confined space entry procedure to ensure that the silo atmosphere is safe before sending anyone in. An electronic direct reading instrument should be used to measure the oxygen level and the concentrations of carbon dioxide and nitrogen dioxide.

Among the 134 victims who died from silo related incidents in the United States (2011-2019), approximately 48% were self-employed individuals including farm family members. Even though family farms without employees are exempt from OSHA regulations, it is imperative for family farm owners to set up and follow safe confined space entry procedure to keep family members safe.

Recommendation #4: Farm owners should provide adequate artificial light source to illuminate silo interior.

Discussion: In this case, the silo interior was illuminated by only a small amount of natural light that entered through the roof fill door and the access door/opening in the base of the silo. The incident occurred in a midsummer evening approximately 9:00 p.m. when the last remaining natural light was diminishing. Poor visibility caused by inadequate lighting could have contributed to the fatal entanglement. Farm owners should provide artificial lighting to ensure that the work can be safely done inside a silo when natural light does not provide good visibility.

The interior of most if not all upright farm silos are poorly illuminated due to their basic overall design and structure. Working in a poorly illuminated confined area greatly increases workers' risks for slips and falls, as well as contact injuries including entanglement. Therefore, it is imperative to de-energize all machinery before entry to ensure worker safety.

Recommendation #5: Farm owners should ensure that no one wears loose fitting clothing around rotating or revolving machinery.

Discussion: During the course of the investigation, it was determined that the decedent was likely caught in the auger from his pant leg causing the fatal entanglement. This particular sweep auger has protruding objects on it, which likely increase workers' risk for entanglement. Farm owners should ensure that no ones' clothing and hair are loose or long enough to get caught in rotating or revolving pieces of machinery.

Recommendation #6: Farm owners should assign age-appropriate tasks to farm youth and provide proper training and supervision.

Discussion: According to National Children’s Center for Rural and Agricultural Health and Safety, a child (<18 years of age) dies about every three days in an agriculture-related incident (U.S. 1995-2000). The leading causes of these fatal injuries were transportation incident (47%), contact with machinery (20%), and violent contact with animals or other humans (13%). From 2001 to 2015, 48% of all fatal injuries to young workers occurred in agriculture. Since 2009, youth worker fatalities in agriculture have exceeded all other industries combined.

The Fair Labor Standards Act (FLSA) sets federal standards for youth employment in agriculture. The FLSA prohibits youths under age 16 years from performing “hazardous” jobs on a farm for employment. The hazardous jobs range from operating a tractor of over 20 PTO (power take off) horsepower or farm machinery, such as an auger conveyor to working inside a grain storage structure that is designed to retain an oxygen-deficient atmosphere. However, FLSA exempts family farms owned or operated by parents of the working youths: “Youth of any age may work at any time in any job on a farm owned or operated by their parents.”

Youth who work on family farms are often assigned and perform varied farm tasks at a very young age. These tasks range from simple chores such as feeding small animals to operating modern farm equipment. Farm youth often perform tasks that are deemed by child labor laws as hazardous for minors below certain age.

Compared to adults, youth may lack work experience, physical size, and attention to tasks. The ability of youth to safely operate farm equipment may be compromised by cognitive abilities that are less well developed than in adults. Whenever youth are assigned any work task, it is essential that the task is appropriate for the age and maturity of the youth. Family farm owners should assess the work environment to ensure that it is safe and free of hazards. In addition, youth should always be trained to safely perform any assigned task and properly supervised by an adult until it is determined that the youth has learned how to safely perform the task.

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INVESTIGATOR INFORMATION

This investigation was conducted by NY FACE, Bureau of Occupational Health and Injury Prevention, Center for Environmental Health, New York State Department of Health.

ACKNOWLEDGEMENT

The NY FACE Program would like to acknowledge the New York Center for Agricultural Medicine and Health (NYCAMH)/Northeast Center for Occupational Health and Safety in Agriculture, Forestry and Fishing (NEC) and the Mennonite community leader for their assistance with this investigation.

Our deepest gratitude goes to the family of the decedent, who graciously agreed to provide information that is invaluable for future prevention of similar incidents.