

2025 Summary of U.S. Agricultural Confined Space-related Injuries and Fatalities

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Highlights

The following are highlights from the 2025 summary of injuries and fatalities associated with agricultural confined spaces:

- No fewer than 48 cases involving agricultural confined spaces were documented, including 22 fatal and 26 non-fatal cases¹, representing a 5.9% decrease over the 51 cases in 2024, and substantially lower than the 10-year average of approximately 60.
- There were no fewer than 21 grain-related entrapments in 2025 representing a 38% decrease from 2024, with the balance of 27 involving livestock waste handling facilities, entanglements and falls in and around grain storage and handling facilities.
- Four incidents involved livestock waste storage pits or lagoons, resulting in ten fatalities, including six in one incident.
- Three cases involved a female in 2025.
- 46% (22) of 2025 cases were fatal, substantially lower than 58% historically
- Minnesota was identified with the most confined space-related cases in 2025 (8), followed by Colorado (7), and Indiana (6).
- Indiana and Minnesota reported the most grain-entrapment cases in 2025 (5), followed by Illinois with 3 cases. The frequency of these incidents, however, remains relatively rare.
- Vertical or tower forage silo incidents accounted for three fatalities and three non-fatal cases.

¹ A case refers to one individual. Some incidents involve multiple victims or cases.

- OSHA Regions 5 and 7 continues to account for approximately 67.7% of all documented agricultural confined space-related incidents.

Introduction

Since the 1970's, Purdue University's Agricultural and Biological Engineering Department has been documenting and investigating incidents involving grain storage and handling facilities at both commercial and on-farm locations. Beginning in 2013, the effort was expanded with support from a U.S. Department of Labor Susan Harwood Training Grant, to include incidents involving other agricultural confined spaces, including grain transport vehicles (trucks, wagons, railcars); injuries occurring inside of confined spaces due to exposure to powered mechanical components, such as augers; falls from or into confined spaces; and other types of agricultural confined spaces including forage storage tower and bunk silos, liquid storage tanks, manure storage facilities and transport vehicles. Data has been coded and stored in the Purdue Agricultural Confined Space Incident Database (PACSID).

To learn more about the process of identifying, documenting, and coding the data for this report, please refer to the previous summaries available at www.agconfinedspaces.org. The methodology employed has remained largely consistent for multiple years.

As of the end of 2025, the PACSID contained information on 2,477 cases, documented between 1962 and 2025,² that resulted in injury, fatality, or required emergency extrication by first responders. In the database, 58.6% of documented cases were reported as grain-related entrapments, making it the leading cause of agricultural confined space-related incidents. Approximately 58% of all documented cases have historically resulted in fatality.

The total number of cases in previous summaries may differ as additional cases from previously unreported incidents are documented. Also, earlier years of surveillance focused only on grain storage and handling-related confined spaces, while later years have included incidents like falls, entanglements, asphyxiations, and drownings in manure storage facilities and other agricultural confined spaces.

As noted in previous summaries³, there is no claim that the data presented accounts for all incidents involving agricultural confined spaces. The early focus on grain-related incidents has resulted in the disproportionate number of these cases included in the database. Furthermore, there is no comprehensive public record of these incidents because most agricultural workplaces

² There is one case in the database that occurred in 1956.

³ See www.agconfinedspaces.org for earlier summaries.

are not covered by a mandatory or comprehensive incident and injury reporting system. In addition, there has been reluctance on the part of some victims and employers to report “near-misses” or non-fatal confined space-related incidents, especially those occurring on farms, feedlots and seed processing operations not covered by federal OSHA injury reporting requirements. Based upon earlier research, it is estimated that approximately 30% of cases go unreported or undocumented using current surveillance strategies. (Riedel and Field, 2013).

This report summarizes cases documented in 2025 and provides an updated historical perspective, including trends. Specific attention is given to cases involving grain storage and handling facilities (which accounted for most cases), and manure storage and handling operations, the second largest category of incidents. The report also provides a brief overview of the fires and explosions that have occurred at grain storage and handling facilities, a summary of incidents involving bunk silos, observations regarding the adequacy of safety training for farm workers and emergency first responders, highlights the growing size of financial settlements resulting from civil litigation associated with these occurrences, and a preliminary summary of incidents involving vertical or tower silos used to store silage and other forages.

The reason for annually releasing this incident data has remained unchanged. The primary aim is to reduce the frequency and severity of such incidents by keeping the public and agricultural producers and employers aware of the issues, contributing to the development of more effective, evidence-based, prevention and injury reduction methods, and giving direction to policymakers and engineering organizations in developing improved safety and health workplace regulations and engineering standards for future construction of related facilities.

2025 Summary of All Documented Agricultural-Confined Space-Related Cases

In 2025, a total of 48 cases were documented, including 21 grain entrapments, 7 falls into or from grain storage structures, 10 asphyxiations due to oxygen-deficient or toxic environments, 8 equipment entanglements (such as those involving in-floor and sweep augers) occurring while working in or around agricultural confined spaces, and 2 incidents involving miscellaneous circumstances (Figure 1). This total represents a 5.9% decrease from 2024. The 2025 total remains substantially below both the five-year average (59.2 cases per year) and the ten-year average (60.2 cases per year) (Figure 2). The five-year total incident average has remained relatively stable in recent years, largely influenced by the unusually high number of cases

documented in 2022 (83). Despite ongoing prevention efforts and increased awareness, the frequency and severity of confined space incidents continue to be a concern and is given considerable media attention.

Earlier increases in reported cases were largely due to improved documentation through expanded on-line surveillance, greater online access to case details, and broader inclusion of incidents involving livestock waste storage and enclosed transport vehicles.

In 2025, there were 22 fatal cases, which is below the 5-year average of 24. Since 2023, there has been a slight downward trend in confined space-related fatalities, but adequate longitudinal data is not available to confirm that this change will continue. While this decline may reflect improvements in safety awareness, equipment, or response protocols, the continued occurrence of about 2 incidents per month highlights the need for sustained prevention efforts and targeted training—especially related to high-risk tasks such as accessing manure storage areas and tower silos. This pattern reinforces the importance of long-term strategies to reduce risks.

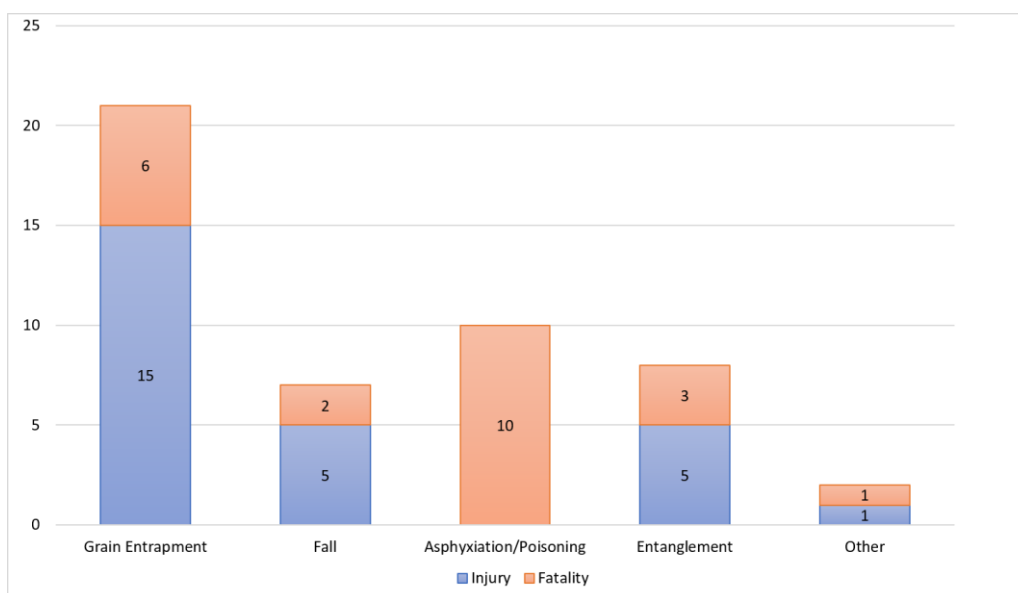


Figure 1. Distribution of all 2025 agricultural confined space-related cases by type of incident (n=48)

In 2025 grain entrapments, both fatal and non-fatal, accounted for 21 cases (44%), with a greater proportion than usual of other types of cases being reported (Figure 2). This change is largely due to one incident involving six fatalities in a livestock waste storage facility in Colorado. Historically, fatal cases have exceeded non-fatal cases, suggesting under-reporting of non-fatal incidents. Increased training for first responders may contribute to improved rescue outcomes, though no reliable research confirms a relationship between proper emergency response training and reduced frequency of fatal incidents. However, in 2025, 46% of all cases

were fatal. While prior data suggest that approximately 58% of confined space related victims are deceased before first responders arrive at the scene. In 2025, 28.6% of all grain entrapments were fatal.

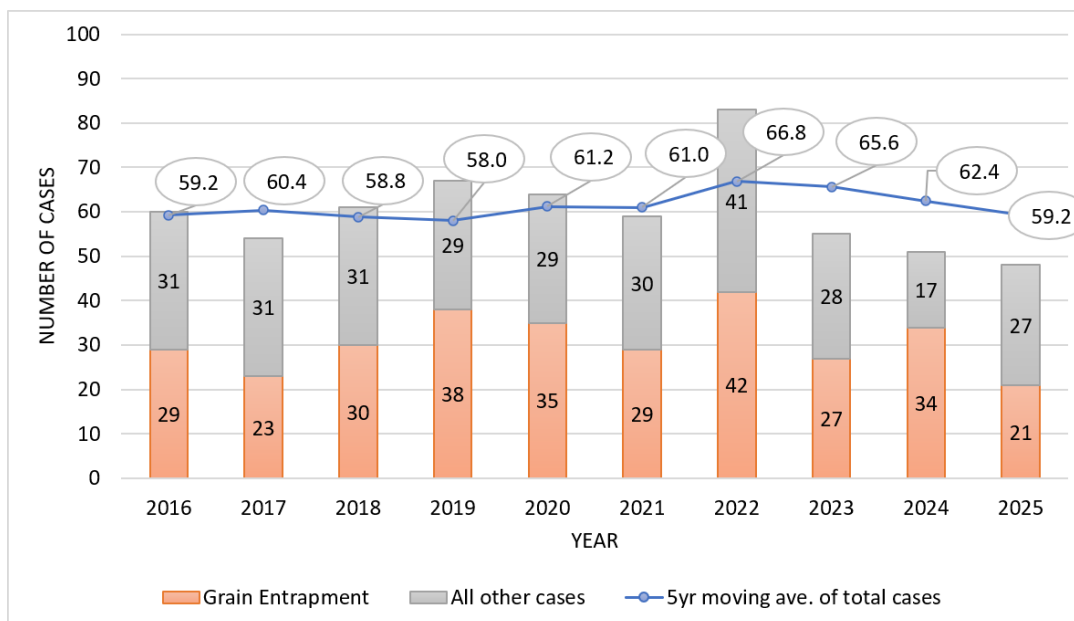


Figure 2. Comparison of the number of grain entrapment cases versus all other confined space cases recorded between 2016 to 2025

During 2025, incidents were documented in 16 states as illustrated in Figure 3. The geographic distribution of all documented cases in the PACSID are included. The total does not include 70 cases where the state was not clearly identified because the site of the incident may have varied from the state in which the victim died.

The states with the most documented agricultural confined space cases of all types in 2025, including fatal and non-fatal, were Minnesota (8), Colorado (7), Indiana (6), and Texas (5). Historically, the four states with the largest number of cases have been Iowa (298), Indiana (251), Minnesota (240), and Illinois (238). Again, current surveillance efforts may underreport cases by up to 30%, mainly due to inadequate reporting mechanisms. Additionally, Indiana likely ranks higher than should be expected due to proactive surveillance measures implemented over the past four decades.

A specific age was known for 29 of the 48 victims in 2025. Two cases involved children or youth under the age of 21, Those over the age of 60 accounted for 13 (27%) of the cases where age was known, possibly reflecting the increasing average age of U.S. farmers (57.5 years old) As noted, 19 cases in 2025 were reported without the victim's specific age, but the context of the reports indicated that nearly all were adults.

Analysis on the Distribution of Incident Type and Facility by US and OSHA Regions.

In 2025, there were 37 cases where the exemption status⁴ of the facility with respect to OSHA regulations was known. The majority of these known cases occurred on farms or other locations currently exempt from enforcement under the OSHA Grain Handling Facilities Standards (29 CFR 1910.272) or Confined Space Standards (29 CFR 1910.146). The balance of known cases, 9, took place at non-exempt commercial grain facilities. Based on historical data, it is believed that most cases for which OSHA status could not be determined occurred at OSHA-exempt sites, such as farms.

⁴ Under the current provisions of the two OSHA workplace safety and health standards most relevant to agricultural confined spaces, agricultural worksites, including most farms, feedlots, and certain seed processing operations are exempt from compliance with confined space entry provisions and reporting requirements.

All 2,477 documented agricultural confined space cases have been identified by OSHA region. While such incidents have occurred in every region, they are most concentrated in Region 5 and 7 (Figure 4). Region 5 accounts for the largest share, with 1,087 cases (43.8% of the national total), including 58.2% involving grain entrapments and 12.4% involving falls. Region 7 follows with 593 cases (23.9%), of which 64.6% were grain entrapments. Region 1 reported the fewest grain entrapments, while Region 6 had the highest proportion of its total cases attributed to grain entrapments (70.5%).

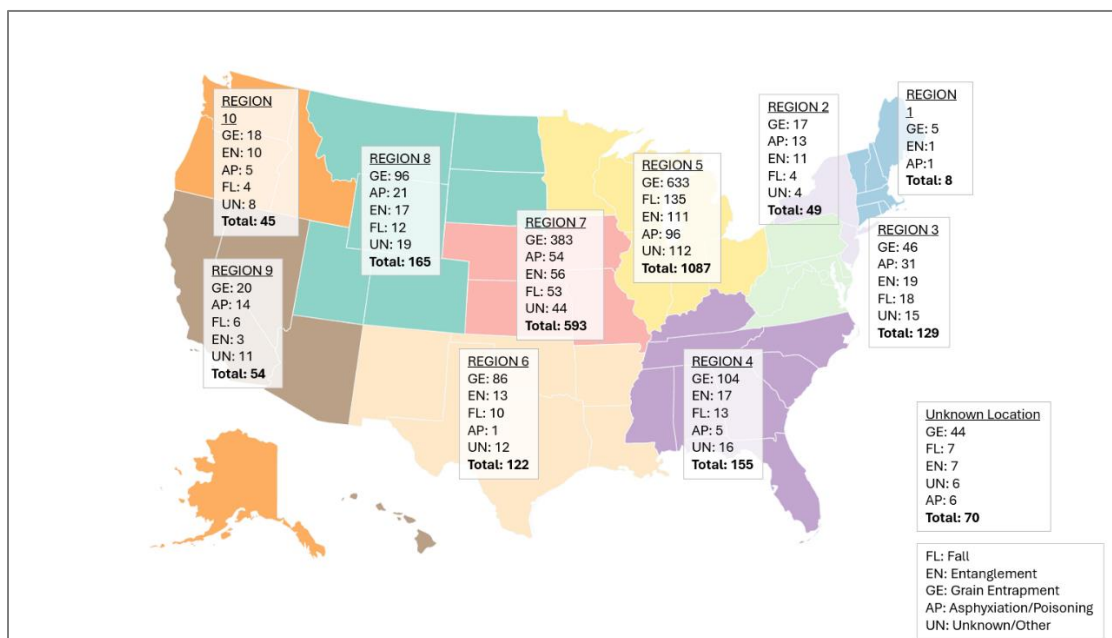


Figure 4. Agricultural confined case distribution by OSHA region from 1962-2025. The total number of cases and most frequent type of case is listed for each region (n=2477)

Grain Entrapments

There were 21 grain entrapment incidents (fatal and non-fatal) documented in 2025, representing a substantial decrease from approximately 34 cases in 2024—roughly a 38% decline—and falling well below the recent five-year average (30.6). Over the longer term, the average number of incidents has remained relatively stable, with only a slight upward trend in frequency over the past decade. Despite year-to-year fluctuations, these patterns indicate relative consistency without a clear long-term decline. In 2025, the fatality rate for grain entrapments was 28.6%, a marked decrease from 41.2% in 2024. While overall agricultural-related incident counts remain relatively stable, grain entrapments continue to pose a disproportionate risk due to their historically higher fatality rates compared to other incident types, underscoring the need for continued focus on prevention and safety interventions (Figure 5). Additionally, the number of

reported non-fatal injuries can be considered a contributing factor influencing the overall fatality rate. This helps explain why, in 2022, the total number of incidents was relatively high while the fatality rate remained comparatively low when contrasted with 2023.

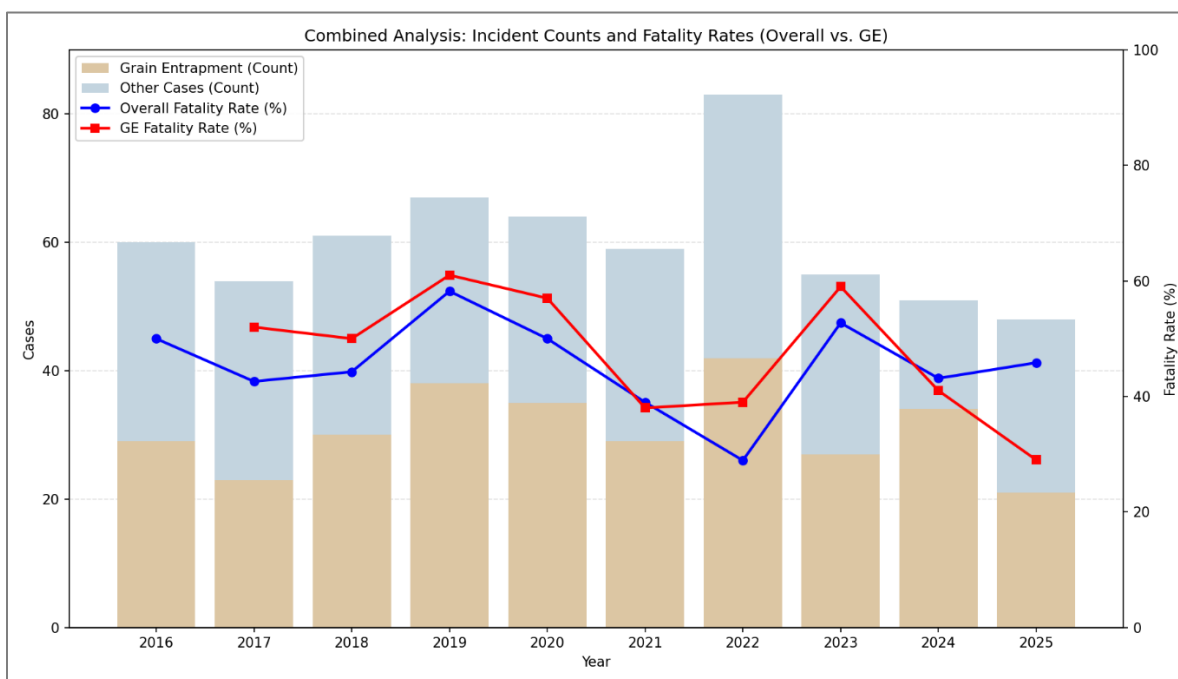


Figure 5. Distribution of fatal and non-fatal grain entrapment cases from 2016 and 2025

The state with the most documented grain entrapments (fatal and non-fatal), was Indiana with five, followed by Missouri with four, and Minnesota with three cases. The majority of grain entrapment cases occurred in the Midwest, or Corn Belt (55.9%). Figure 6 provides a geographic distribution of all documented grain entrapment cases contained in the PACSID for which the incident location was known. Indiana continues to have the highest cumulative number of documented grain entrapment cases. Considering the total grain production and grain storage capacity, Iowa, Illinois, and Minnesota ought to have a significantly greater number of cases than reported in Indiana. As noted, however, Indiana has had a more aggressive surveillance program for this type of incident for over 40 years.

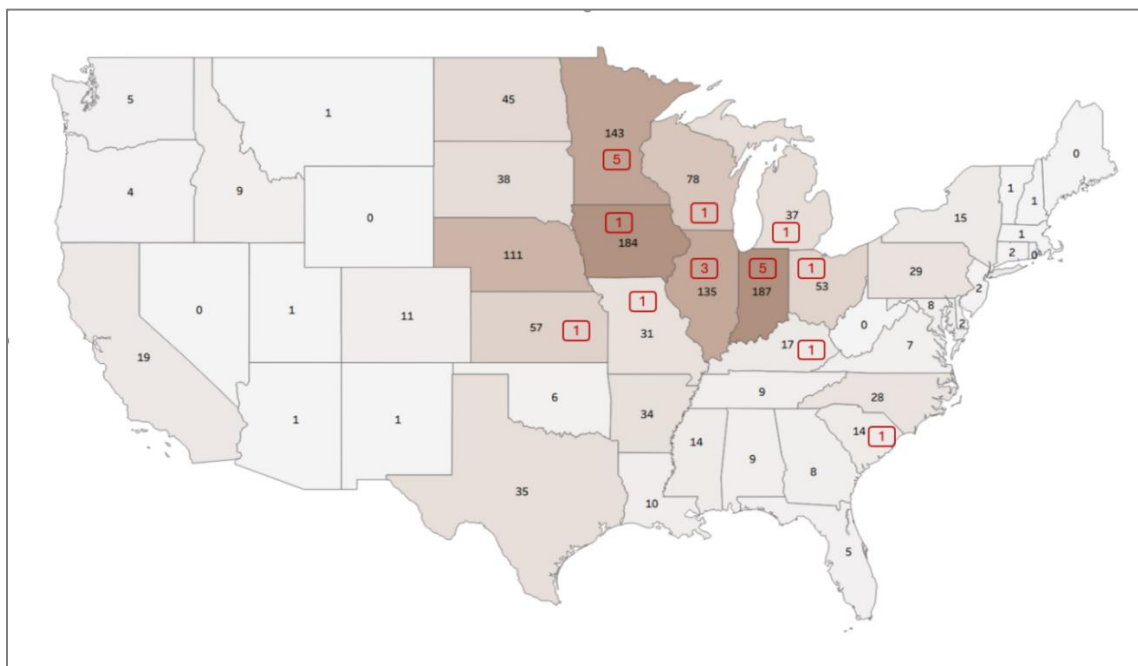


Figure 6. Geographic distribution of grain entrapment cases in 2025 and previous years (n=1451)

One documented grain entrapment was female, and all other cases were male, which has been historically the case. The oldest victim of grain entrapment was 85. The average age was 67.3 years old, and the median age was 66. In over 57% of cases, the specific age has been documented, and the review of the reports strongly indicates that nearly all were adults. Over two-thirds of current U.S. grain storage capacity is on farms which are largely exempt from OSHA injury reporting requirements, and it is highly likely, as noted, that this summary does not encompass all grain-related entrapments, whether resulting in death or not.

Summary of Grain Dust Related Explosions⁵

Seven U.S. grain dust explosions in 2025 caused ten injuries and four fatalities. The number of explosions is slightly below the 10-year average of 8.5 explosions, however, the number of injuries and fatalities increased compared to two injuries and no fatalities in 2024. The explosions occurred in one feed mill, two grain elevators, one seed processing plant, one biofuel plant, one flour milling plant, and one farm operated grain elevator. Explosions occurred in five different states with two each in Texas and Ohio, and one each in Minnesota, North Dakota, and Nebraska.

⁵ Grain dust explosion-related injuries are not included in the data reported in this summary. For additional information, please refer to Dr. Kingsly Ambrose's report on grain dust explosions.

Agricultural Waste Storage, Handling, Transport Equipment and Facility-related Incidents

The last published summary of agricultural waste related incidents was published by Nour et al in 2021 (see Published Works). The database now contains approximately 450 of these incidents, with the majority being fatal. A significant characteristic of these incidents is the high risk of secondary victims. In 2025 six workers died in a livestock waste storage facility in Colorado. Five of the victims were secondary victims attempting to rescue the initial victim. This event was significant in that it accounted for 12.5% of all cases documented.

Summary of Bunker Silo-related Incidents

Horizontal bunk silos and open silage storage have increasingly replaced traditional tower silos in dairy and beef operations due to their larger storage capacity, improved efficiency, and enhanced silage quality. These designs reduce the need to climb tall structures and enable faster filling and unloading, improving packing density and feed consistency. However, despite these benefits, several serious injuries and fatalities—though relatively rare—have drawn attention from safety professionals and regulatory agencies. A review of approximately 2,477 agricultural confined space incidents currently documented in the PACSID, and multiple on-line sources, identified 33 cases (35 individuals) involving bunk-type or open silage storage between 1962 and 2023. There were no documented cases in 2024 or 2025. Most incidents were linked to silage collapse from the face of the pile, tractor rollovers during packing, and falls from silage surfaces. Victims included farm workers, and at least two veterinarians retrieving silage samples. Key prevention strategies being recommended include avoiding overfilling, prohibiting access to unstable silage faces, using safe unloading equipment that provides operator overhead protection, and restricting packing operations to vehicles with rollover protection (ROPS). While the low frequency of incidents suggests additional regulation may not be warranted, improved safety standards and signage should be considered to reduce risk.

Efforts to estimate the frequency and severity of bunker silo-related incidents are ongoing, and surveillance will continue to expand as resources permit. Additional information or documentation related to bunker silo injuries and fatalities would be greatly appreciated.

Summary of Vertical/Tower Silo-related Incidents

As part of Purdue University's on-going surveillance of agricultural confined space related incidents, cases involving vertical/ tower silos are now being identified. To better understand the safety and health issues related to these structures, data regarding documented cases are being compiled separately as a new initiative. Findings will be used to enhance the quality of current agricultural safety and health educational resources.

Historically these structures have played a significant role in the expansion of livestock-based agriculture with an estimated 500,000 units in use on farms during their peak. These facilities consisted of primarily older wooden stave silos, tile silos, concrete stave silos, poured concrete silos, and oxygen limited structures fabricated from glass coated steel. Units are designed to be filled using an external silage blower, with contents removed via top or bottom unloading systems. Currently, vertical/ tower silos are rapidly being replaced by either bunker silos, open piles of covered silage, or silage bagging operations. Many current silo structures have outlived their anticipated life expectancy and have been abandoned.

Utilizing documented cases in the PACSID and a preliminary review of online sources, no fewer than 104 incidents involving 127 individuals (cases) were documented. Of these cases, 75 % were fatal, reflecting a higher proportion of fatalities than incidents involving grain storage bins. Males accounted for 92% of the cases. When the age of victims could be ascertained, the average age of all victims was 37. The most common incident types involved exposure to toxic gases, with "silo gas", "nitrogen dioxide", or "nitrous oxide" identified most frequently in 32% of cases. The next largest category involved falls from silos, at 23%. Entanglement in silo loading or unloading equipment were associated with 17% of cases. Initially unexpected were the 9 incidents involving 6 fatalities that were caused by collapsing silo structures. States with the most frequently reported incidents were Wisconsin, Pennsylvania, Minnesota, and New York, reflecting the close association of these structures with the historic dairy industry.

In 2023, seven incidents involving vertical/ tower silos were documented with four resulting in fatalities. The average age of the victims was 44 when age could be determined. All known victims were male. Exposure to "silo gas" leading to asphyxiation resulted in one fatality, two cases were caused by falls, two cases involved entanglement in loading and unloading equipment, and one fatal case involved a falling object within the silo.

This is the first concerted attempt to estimate the frequency and severity of tower silo-related incidents and surveillance will continue to be expanded as resources allow. Information on silo-related injuries and fatalities would be appreciated.

Are We Conducting the Right Emergency Response Training?

Ongoing surveillance of the media for incidents involving agricultural confined spaces has continued to identify a high frequency of reports related to training taking place for local emergency first responders. These training events are occurring across the U.S., even in areas where the probability of a grain-related entrapment is extremely low, or historically non-existent. The primary focus of the training, as reported by the media, has been to address strategies to rescue victims from partial entrapment utilizing on-site fabricated or commercially available grain rescue tubes or cofferdams. In many cases, the training appeared to be a response to a local incident, which may have been the only such incident ever documented in the service area. Millions of dollars have been spent on these trainings and acquisition of specialized equipment, even in light of the fact that only about 30-35 such incidents occur annually in the entire U.S., and the majority (approximately 60%) of victims, historically, have died before the arrival of emergency services.

From a public policy perspective, the following questions should be asked: (a) Is the current level of training activities actually justified? (b) Who are the most appropriate first responders to receive the training? (c) What should the learning outcomes be for agricultural-confined space rescue training? (d) How much specialized rescue equipment is actually needed and where should it be located for rapid deployment? And (e) Have the risks to first responders been clearly identified?

Considering the increase in the number of incidents involving livestock waste-related facilities, increased documentation of multiple, or secondary victims, and the growth in the number of confined spaces found on agricultural operations, it would seem appropriate that training being offered on the hazards associated with extricating victims from related confined spaces should be more comprehensive, and in alignment with actual incident data. The review of current online sources found little attention being given to this gap in training. Another important gap identified in current training resources is the primary emphasis being placed on the entrapped victim with little attention being given to the potential risks to, often untrained, first

responders of becoming secondary victims at the scene. It appears that greater attention needs to be given to first responder safety. In fact, this focus should be a focus of all fire/rescue training.

The need for consistent evidence-based first responder training strategies for rescues from all types of agricultural confined spaces appears to be justified.

The Cost of Agricultural Confined Space-Related Incidents is Increasing

In the past, the economic consequences related to fatalities or injuries occurring in agricultural confined spaces were relatively minor and usually taken care of by the affected family, farm or agribusiness, insurance policies with modest coverage, Worker Compensation Insurance, or through support from the local community. With enhanced enforcement of OSHA workplace safety and health regulations, non-exempt employers became exposed to greater risk of financial and criminal penalties for failure to provide a safe workplace. Employers, both exempt and non-exempt, have become increasingly aware of the financial compensation granted through civil litigation in cases involving injuries or fatalities in agricultural confined spaces. Juries have sent a clear message to employers that ignoring the well-being of employees will be very expensive. In recent fatal incidents involving grain bins and livestock waste facilities, the OSHA fines have been relatively insignificant (\$50-100,000), compared to the \$10-17 million legal settlements that have been documented. Even for a large business, these costs are difficult to overlook or absorb. In at least two documented cases, criminal charges were considered by local and federal prosecutors against negligent employers.

Project Website

With support from a Susan Harwood Grant from the U.S. Department of Labor, the website (www.agconfinedspaces.org) was developed to provide resources for those conducting safety and health training in the area of agricultural confined spaces, with an emphasis on grain storage and handling hazards. This site continues to be updated, and now includes training material, frequently asked questions, past summaries of injuries and fatalities, and an extensive list of on-line resources. Since 2019 it has hosted nearly 42,500 visitors.

One of the most frequently visited resources on the website is the curriculum developed for young and beginning workers in the grain industry (**Against the Grain**). The goal of this teaching resource is to provide agricultural and safety educators with an evidence-based 3–5-

hour program to present basic safety and health awareness training to youth, ages 16-21, and new employees who are employed at grain handling and storage facilities, including both exempt and non-exempt operations. The curriculum has been delivered to over 5,100 youth in secondary school agricultural education programs, informal out-of-school settings, and college level agriculture classrooms. Pre- and post-testing have demonstrated a significant knowledge gain and instructor feedback has been very positive. The complete curriculum is available as a free download.

Another educational resource at the site is designed for use in training emergency first responders to safely and effectively respond to incidents at grain storage and handling facilities. Over the past 10 years over 5,500 emergency first responders have participated in training using this first responder material. The curriculum is also available as a free download.

Also, check out the **Gearing Up for Safety** training material at www.agsafety4youth.info which includes two educational lessons on agricultural confined spaces. These materials can be downloaded for free.

Educational Resource

In 2018, Purdue's Agricultural Safety and Health Program collaborated with the Posey County Farm Bureau to produce STOP – THINK – LIVE, a video that re-enacts the actual grain bin entrapment of a Posey County, Indiana farmer. Copies have been distributed to over 675 County Farm Bureau presidents, secondary agriculture education teachers, County Extension offices and many first responder agencies. The video includes interviews with the farmer, shows the rescue strategies used, and has short outtakes on the role of out-of-condition grain and the risk of entrapment in grain transport vehicles. The video can be viewed at www.agconfinedspaces.org or copies can be ordered for \$10.00 from:

Posey County Farm Bureau
PO Box 189
30 West Main Street,
Poseyville, IN 47633-0189

Published Works

As the result of the analysis of data gathered over the past 13 years, the following peer-reviewed articles have been published. Full text for some of these articles are available at www.agconfinedspaces.org.

- Roberts, M. J. Field, W. E., Maier, D. E., Stroshine, R. L. Determination of Effort Required to Insert a Rescue Tube into Various Grain Types. *Journal of Agricultural Safety and Health*, 18:4, 2012.
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For additional information on this report, contact Professor Bill Field at 765-494-1191 or field@purdue.edu. In addition, refer to these sources for more information on this topic:

- www.agconfinedspaces.org
- www.grainsafety.org
- <http://apps.npr.org/buried-in-grain/>
- www.agsafety4youth.info
- OSHA.gov/grain-handling
- Standup4grainsafety.org
- Nfga.org/resources/safety/