Silo Fire/Emergency Awareness Seminar
Eric J. Rickenbach ("EJR")

- 35+ year veteran of the emergency services.
- 20+ year instructor, specializing all levels of vehicle rescue, and farm / agricultural emergencies, teaching in local, national, and international venues.
- Serve on several local, state, and national level committees for both vehicle and farm/ag rescue and safety.
- Emergency response consultant for farm/ag emergency incidents throughout PA and other areas as requested.
Course Goal

This seminar is designed to give emergency responders information on the planning for and the initial management of silo related emergencies.
Course Objectives

At the conclusion of this awareness level seminar, the student will be able to…

1) … discuss relevant OSHA and NFPA standards related to silos.

2) … explain the importance of pre-incident planning relating to silo incidents.

3) … identify the basic silo construction and unloader types.
Course Objectives

At the conclusion of this awareness level seminar, the student will be able to…

4) … explain the initial management actions that should be completed for various silo related emergencies.

5) … identify additional resources to be considered at silo incidents.

6) … identify additional training that can be obtained to assist in response to silo incidents.
This seminar is NOT designed to teach fire fighting or rescue operations!
(That a whole other set of training.)

It is intended to prevent responders from getting hurt and/or blowing things up in the initial response to a silo incident.
So why are we here?

First, let’s look where we are…
January, 2017
Montgomery County, PA

September, 2014
Lancaster County, PA

July 2016
Lancaster County, PA
Second, let’s look what can happen…
Volunteer Assistant Fire Chief Dies at a Silo Fire/Explosion - New York

Photo: NIOSH
Contributing Factors

• unrecognized hazards associated with a silo fire

• closing and securing the hatches on top of the silo.
Key Recommendations

1. Review, revise, and enforce standard operating guidelines (SOGs) for structural fire fighting that include oxygen-limiting silos

2. Train officers and fire fighters on the hazards associated with different types of silos and the appropriate fire fighting tactics

3. Ensure that pre-emergency planning is completed for all types of silos located within fire department jurisdictions
Key Recommendations

4. Consider requiring that placards with hazard warnings and appropriate fire fighting guidelines be placed on silos.

5. Consider silos as confined spaces and recognize the dangers associated with confined spaces when responding to silo fires.

6. Ensure that an Incident Safety Officer is deployed at technical or complex operations.
"Confined space" means a space that:

(1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and

(2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and

(3) Is not designed for continuous employee occupancy.
"Hazardous Atmosphere"

Means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

1. Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
2. Airborne combustible dust at a concentration that meets or exceeds its LFL;
   NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.
3. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
4. Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;
5. Any other atmospheric condition that is immediately dangerous to life or health.
NFPA 1670 - Standard on Operations and Training for Technical Search and Rescue Incidents

• Silos are included under the definition of a confined space.

• Chapter 3.3.25 defines a “confined space” as “a space that is large enough and so configured that a person can enter and perform assigned work, that has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, and pits), and that is not designed for continuous human occupancy.”
• When responding to silo fires, fire departments should consider silos to be confined spaces and recognize the dangers associated with confined spaces throughout the incident response.

• Pre-incident planning and risk management analysis for silo operations should consider the dangers and hazards associated with confined spaces. Any operations that could lead to entering a silo should be done in accordance with NFPA 1670.
What does all this mean when it comes to a silo incident???
Responding to a SILO incident.

- **S**low down.
- **I**dentify the silo.
- **L**ook, listen and isolate.
- **O**rganize the scene and review the options.
“Pre-Response” Activities
(aka: Pre-Planning)

Have you evaluated the silos in your district?
✓ How many?
✓ What is your department’s potential for dealing with one?
✓ Could you respond in a mutual aid role?
Have you evaluated the silos in your district?

Are you in downtown Harrisburg? …or rural Snyder County?
Have you evaluated the silos in your district?

105 ft

148 ft
Types of Silos

• Three common types:
  – Conventional
  – Oxygen limiting
  – Modified

• **Determining the type of silo is NOT just a matter of looking at it.**
Types of Silos
Silo Construction

- Poured concrete
- Concrete stave
- Concrete block
- Steel/glass-lined
- Wood
- Tile
- Converted?
- Plastic lined?
Types of Unloading Systems

Types
• Top unloader
• Bottom unloader
• “Big Jim”

Power Sources
• Electric
• Hydraulic
• Human
Conventional Silo

• Construction
  – Poured concrete
  – Concrete staves
  – Other: steel, tile, or wood, fiberglass

• Unloading chute

• External ladder/platform

• Domed or no roof

• Fill pipe
Conventional Silos
Electric Top Unloader
Top Unloader
Video courtesy of J&J Silo
Hydraulic Top Unloader

Photos: J & J Silo Company
Oxygen Limiting Silos

• Construction
  – Glass lined steel panels bolted together
  – Poured concrete
• Unloader normally on bottom, unless modified then on top
Oxygen Limiting Silos
Oxygen Limiting Silo Controlled Atmosphere

- Designed to keep air out - normal environment is ~4% oxygen.
- Accomplished through the use of “breather bags”.

Graphic: CST Industries
Oxygen Limiting Silos

- Filled with outside fill pipe-to center of roof
- Open and close top hatch for fill pipe
- No need to enter - unless tool or object is dropped from top hatch
- Open and close bottom hatch for unloader
- Occasionally must crawl in unloader space to service unloader

Graphic: CST Industries
Bottom Unloader
Modified Oxygen Limiting Silo

- Unloader has been installed to top
- Conventional unloader
- “Big Jim” unloader
- Dilemma—is it now a conventional silo?
- Determine oxygen and carbon monoxide levels prior to any mitigation activities.
- **It should be treated as oxygen limiting for emergency response purposes.**
Type of silo?
Type of silo?
Type of silo?
Type of silo?
Type of silo?
Type of silo?
Big Jim-Type Unloader
Big Jim-Type Unloader
Power Sources:

- Electric
- Hydraulic
Silo Liners
Accessibility???

Topography, silo placement, other structures, apparatus limitations, etc. may or may not allow for proper/meaningful apparatus placement.
Accessibility???
Silo Manufacturers and Service Personnel

• Develop a resource list for your area.
• Check with the farmer to see who he uses for service, etc.
• Should be consulted VERY EARLY in the incident.
• Keep in mind, they may choose NOT to provide assistance depending on the scenario.
Break Time!

It's time for the intermission!

Let's grab ourselves a snack!
Equipment for Dealing With Silo Incidents

• If you don’t have it where are you getting it?
• Mutual aid capability?

Courtesy: Blue Rock Fire Rescue
Training?

✓ What is your personal level of training and certification?
✓ What is your organization's level of training and certification?
✓ What type of on-going training does your agency conduct?
✓ What about the training of your mutual aid response agencies?
Silo Incident Response
Initial Actions
Silo Incident Response

• Unless there is a major exposure concern (barn, animals, feed shed, etc.) or a serious life safety issue a silo incident requires a slow and methodical approach.

• If the first officer arrives and finds no exposure or life safety issues, consider a “non-emergent” response.

Photo: Fleetwood Fire Company
Silo Incidents

• Silo incidents (especially fires) do NOT need every piece of fire apparatus from every department within a 50 mile radius.

• Call the appropriate quantity and type of resources…

Photo: Fleetwood Fire Company
Silo Incidents

• The farm environment has many other hazards. Keeping fire fighters in one area will prevent other safety issues.
• Identify personnel who have an understanding of silos to use as potential resources. They can serve as SME’s and can assist with assessment, lock out/tag out, etc.
Silo Incidents

What type of incident is it?
- Fire?
- Rescue?
- Recovery?
- Collapse?
Initial Management for ANY Incident

- Establish incident management system, including an incident safety officer.
- Establish personnel accountability system.
- Scene assessment.
- Evaluate and prioritize life safety issues.
- Evaluate exposure issues.
- Lock out – tag out of involved equipment.
**Initial** Management for ANY Incident

- Keep the farm owner/manager close at hand.
- He knows the particular silo involved better than anyone else.
- Listen to what he is telling you…

Courtesy Fleetwood Fire Company
Identify the following specific information about the silo involved:

- Silo type?
  - Conventional?
  - Oxygen Limiting?
  - Modified?
- Silo dimensions?
- Unloading mechanism/system?
Identify the following specific information about the silo involved:

• Contents?
  – What?
  – When? If recently filled, what percentage of moisture? Is there a river running out of the silo?
  – How much?

• What maintenance has been performed to the silo? When was last maintenance?

• Look at the overall general condition.
Identify the following specific information about the silo involved:

- When/what/who maintenance has been performed to the silo.
- Look at the overall general condition.
Work with the farmer…

• Remind/ask if there are provisions for feeding and/or moving animals (without the feed in the silos).

• Keep in mind that certain farm functions must continue during your operations (milking, etc).

• Has the farmer contacted his insurance company?
Look, Listen, and Isolate

Look at what is going on. *This does not require immediate entry into a silo to determine…*
Look, Listen, and Isolate
Fire Incidents
Make sure you know what you are looking at?

Is it smoke?

...or is it gas?
Visible fire?

- Charring?
- Doors or portions of them falling down the unloading chute?
What is thermal imaging and heat gun telling you?
What are gas meters telling you?

✓ What *should* they be telling you???
✓ Are you metering for the *correct* things?
✓ Are you *interpreting* the readings correctly?
✓ Do you *regularly* practice with your meters?
What to meter for?

Oxygen
Carbon Monoxide
Carbon Dioxide
Nitrogen Dioxide

Not every department has the capability…
Organize your scene & crew!

• Create working zones around the silo.
• Reinforce personnel staging and accountability.
• Move endangered people away from the scene.
• If safe to do so, move endangered livestock.
Lock Out / Tag Out

Initiate lock out/tag out by securing all utilities.

- Electric
- Hydraulic
- Other?
  (Computers?)
Specific Initial Management
Fires

• Limit air movement into silo if possible.
• Move/protect exposures.
• Move/protect equipment. Raise the unloader if possible.
• If not sure what to do next, contact silo company or ag specialists to assist with further extinguishment decisions.
Specific Initial Management Fires

DO NOT...

• Dump large amounts of water into the silo.

  You can blow them up!
  You destroy good feed!

• Attempt to immediately place any personnel into the silo by any means.

  There is no reason to!
  Remember it’s a confined space!
Specific Initial Management
Rescue / Recovery

- Ventilate the silo, using the blower if possible.
- Attempt to make contact with the victim from outside the silo.
- Contact additional technical rescue resources as necessary.
Specific Initial Management
Rescue / Recovery

**DO NOT…**

- Attempt to immediately place any personnel into the silo by any means.  
  There is no reason to!  
  Remember it’s a confined space!
- Create more victims!
Specific Initial Management [Potential] Collapse

- Establish collapse zone.
- Move people and animals to a safe area.
- Control utilities.
- Contact silo companies and engineers for further action.
Specific Initial Management
[Potential] Collapse

**DO NOT...**

- Attempt to brace the silo.
  
  This requires trained silo people to deal with!
  
  When/how/why/where they will fall is unpredictable!

- Create more victims!
Specific Initial Management
Any Incident

- Remember a slow methodical approach is needed [required]!
- Personnel safety is paramount.
- Do not create additional problems.
- Do not create additional damage/loss.
Technical Assistance

• Get to know your local silo equipment dealers and suppliers. Develop a resource list.
• There is technical assistance for silos (and grain bins) available by contacting your local 9-1-1 Center or the PEMA State EOC.
• Don’t be afraid to call!
So now what?

• Training in operational and technical level rescue.
  – Confined space.
  – Ropes & rigging.
  – Aerial apparatus operations.
• Training in silo fire fighting.
• On-going training and practice.
To review...

- Silo incidents require a measured and methodical response.
- The actions by responders in the first few minutes can make-or-break the entire incident.
Thank you for your attention!

Are there any questions?