

**WELCOME**

# **OSHA & COMBUSTIBLE DUST**

**Presented by:**

**Jeffry S. Carter**

Deputy Commissioner of Labor

Indiana Occupational Safety and Health Administration

and

**Jason Reason**

Senior Industrial Hygienist

Indiana Occupational Safety and Health Administration

# Speakers

## Jason Reason

- Senior Industrial Hygienist
- Member NFPA Committee on Combustible Dust
- CIH
- CSP
- CHMM
- Handles many of the more complex IH fatality cases

## Jeff Carter

- Deputy Commissioner & head of IOSHA
- Previously served as an Environmental, Health, and Safety Director with United Technologies Corp.
- Administrative Law Judge, Labor Department 1992-1998

# Current Enforcement

- Indiana uses the General Duty Clause to enforce existing consensus standards
- Various NFPA and other consensus standards may apply
- Trends in Combustible Dust enforcement for Indiana. Relatively few actual investigations

# Current Enforcement

- Much of what we do today is driven by National Emphasis Program (NEP) Directive dated March 11, 2008
- NEPs focus agency resources on a specific typically narrow issue
- Some NEPs are voluntary, Combustible Dust was not one of those

# Future Enforcement

- Advanced Notice of Proposed Rulemaking published 10/21
- Final Rule by mid year 2010 (end of FFY 2010)
- NEP guides our work until then

# Future Enforcement

- New rule likely to look very similar to current NFPA standards
- Will incorporate some provisions from Grain Dust Standard
- Very similar enforcement appearance to what we do today except that it will now be a hazard specific standard

# Enforcement

- How do I know if this applies to my Company?
  - Accumulations of 1/32 of an inch of dust
  - Covering at least 5% total floor area
  - Dust is tested and determined to be “explosive”

# Enforcement

- How did your plant get chosen for an inspection?
  - Formal employee complaint
  - Inter agency referrals
  - Significant incident or event



# Changing Enforcement

- New OSHA attitude in Washington
- Enforcement Driven highly aggressive
- Feds are suspicious of some State Plan State programs
- Nevada report

# Changing Enforcement

- Indiana has increased the number of willful and repeat violations written
- Search warrants can be obtained in as little as 4 hours now
- Post Final Order enforcement tools such as Sheriffs warrants

# Changing Enforcement

- Work with employers “who get it”
- Educational efforts with INSafe
- Improved communication with employers including customer satisfaction cards
- Use of Partnerships and Alliances
- VPP program

# Metrics

- **Governor Daniels**
  - Overall injury rate
  - Number of inspections
  - Number of fatal incidents
- **Federal OSHA**
  - 26 separate data points
  - Some fairly obscure
  - None references overall injury or fatality rate

**SESSION BREAK**

# **IOSHA's ENFORCEMENT OF COMBUSTIBLE DUST STANDARD**

Jason Reason, CIH, CSP, CHMM

# Overview

- Background Information
- OSHA's Current Policies and Procedures for Combustible Dust Inspections
- Some Hazards OSHA Looks for on a Typical Combustible Dust Inspection

# Combustible Dust Definition

- A combustible particulate solid that presents a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations, **regardless of particle size or shape** (Section 3.3.4 of NFPA 654-2006)
- Traditionally a material 420  $\mu\text{m}$  or smaller
  - Capable of passing through a U.S. No. 40 standard sieve
    - Does not have to pass through a U.S. 40 standard sieve to be considered a combustible dust (Section A.3.3.4 of NFPA 654-2006)
- Typically, the finer (smaller) the dust, the more explosive (combustible) it is



# Combustible Dust Definition

- Combustible dust are considered Class II dusts
- Class II Combustible Dusts are divided into three groups
  - Group E: Metal Dusts
  - Group F: Carbonaceous Dusts
  - Group G: All other dusts not found in Groups E or F (flour, grain, wood, plastic, chemicals)

# Other Important Definitions

- Deflagration
  - Propagation of a combustion zone at a velocity that is less than the speed of sound in the unreacted medium
- Air Material Separator
  - A collector designed to separate the conveying air from the material being conveyed
  - Includes dust collectors, baghouses, etc.

# Types of Combustible Dusts

- **Organic Dusts**
  - Sugar, Flour, Paper, Soap, Dried Blood
- **Wood Dusts**
  - All Varieties, Includes Sawdust
- **Metal Dusts**
  - Aluminum, Magnesium
- **Plastic Dusts (Additives)**
- **Carbon Dusts**
  - Coal

# Elements Needed for a Combustible Dust Deflagration

1. Fuel (Combustible Dust)
2. Ignition Source
  - Friction, heat (conduction, convection), electrical, sparks (embers), electrostatic discharge, smoldering nests, hot work (grinding, welding, etc.)
3. Oxygen
4. Dust dispersion
  - Dust cloud at or exceeding the Minimum Explosible Concentration (MEC)
5. Confinement of the dust cloud (fugitive dust emissions)
  - Dust collectors, process machinery

# A HUGE Problem

- Several combustible dust explosions and fires in the United States, including several fatalities
  - Two major combustible dust explosion fatalities in Indiana in the last 5 years
  - Two combustible dust explosions and four combustible dust fires in Indiana in 2009
- OSHA says that 30,000 employers in the United States are at risk for combustible dust fires and/or explosions
- Congress says that 200,000 employers in the United States are at risk for combustible dust fires and/or explosions
- OSHA currently has no specific standard for combustible dust
- OSHA does have a National Emphasis Program (NEP) for combustible dust
  - CPL 03-00-008 (Reissued) - Provides policies and procedures for inspecting workplaces that create or handle combustible dusts that could cause deflagration, fire or explosion

# Combustible Dust Tests (Alphabet Soup)

- Limiting Oxygen Concentration (LOC)
- Minimum Ignition Energy (MIE)
- Minimum Ignition Temperature (MIT)
- Minimum Explosible Concentration (MEC)
- Ignition Sensitivity (IS)
- $K_{st}$
- Explosion Severity (ES)
- Class II
- Maximum Rate of Pressure Rise ( $dp/dt$ )
- Maximum Explosion Pressure ( $P_{max}$ )

# Combustible Dust Sampling

- Take a one liter sample of the combustible dust in a plastic bottle or container
- All I OSHA combustible dust samples are sent to Federal OSHA Lab in Salt Lake City (SLC)
- CSHO specifies to SLC whether they want a  $K_{st}$  or Class II test done on the sample
- SLC uses a low energy and low turbulence test chamber
  - More accurate and protective, but  $K_{st}$  value may be 4-5 times lower compared to other labs
- The employer is **not allowed** to use OSHA's combustible dust sampling results for engineering controls

# Typical $K_{st}$ Values for Common Combustible Dusts

- Cotton: 20-24 b.m/s
- Wood: 26-102 b.m/s
- Paper: 168 b.m/s
- Corn Starch: 128-163 b.m/s
- Wheat Flour: 87-139 b.m/s
- Sugar: 75-154 b.m/s
- Coal: 10-143 b.m/s
- Rubber: 106-138 b.m/s
- Polyethylene (Plastic): 46-156 b.m/s
- Polypropylene (Plastic): 38-101 b.m/s
- Aluminum Powder: 400-1100 b.m/s
- Magnesium: 30-500 b.m/s



# Dust Explosion Classes

Dust Explosion Class	$K_{st}$ (bar.meters/second)	Characteristic
St 0	0	No Explosion
St 1	>0 to $\leq 200$	Weak Explosion
St 2	>200 to $\leq 300$	Strong Explosion
St 3	>300	Very Strong Explosion

# Relevant OSHA Standards for Combustible Dust

- 1910.22 Housekeeping
- 1910.36 Design and Construction for Exit Routes
- 1910.37 Safeguards and Features for Exit Routes
- 1910.38 Emergency Action Plans
- 1910.39 Fire Prevention Plans
- 1910.94 Ventilation
- 1910.132 Personal Protective Equipment
- 1910.145 Specifications for Accident Prevention Signs and Tags
- 1910.146 Permit-Required Confined Spaces
- 1910.157 Fire Extinguishers
- 1910.165 Employee Alarm Systems
- 1910.176 Material Handling
- 1910.178 Powered Industrial Trucks
- 1910.269 Electrical Power Generation
- 1910.272 Grain Handling Facilities
- 1910.307 Hazardous Locations
- 1910.1200 Hazard Communication (HazCom)

# General Duty Clause

- Section 5(a)(1) or Indiana Code (IC) 22-8-1.1, Section 2
  - Employer must “furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm”
- Can be issued for deflagration, explosion or other fire hazards that may be caused by combustible dust within a dust collection system or other containers (mixers, bins, etc.)
- Also can be issued for conditions such as, but not limited to
  - Improper deflagration venting
  - Ductwork-related problems
  - Make-up air systems
  - Improper Work Practices

# General Duty Clause

- Must have a feasible means to abate the hazard in order for OSHA to cite the General Duty Clause
- Compliance Officers are allowed to use the NFPA standards as evidence of feasible means of abatement
  - NFPA standards can also be used for evidence of industry recognition of the hazard

# Four Main NFPA Combustible Dust Standards

- Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities (NFPA 61-2008)
  - Flour, sugar, starch, spices
- Standard for Combustible Metals, Metal Powders and Metal Dusts (NFPA 484-2009)
  - Magnesium, aluminum
- Standard for the Prevention of Fires and Dust Explosions from the Manufacturing, Processing and Handling of Combustible Particulate Solids (NFPA 654-2006)
  - Plastic, paper, rubber, carbon dusts
- Standard for the Prevention of Fires and Dust Explosions in Wood Processing and Woodworking Facilities (NFPA 664-2007)

# Four Main NFPA Combustible Dust Standards

## Similarities

- Require Explosion Protection
- Control Sources of Ignition
- Means of Egress
- Emergency Action Plan
- Housekeeping Requirements
- Employee Training
- Process Safety Management Elements

## Differences

- Industry Specific
- Require Different Forms of Explosion Protection
- Different Ventilation Requirements

# **Additional Combustible Dust Standards**

- **Explosion Protection by Deflagration Venting (NFPA 68-2007)**
- **Explosion Prevention Systems (NFPA 69-2008)**
- **Classification of Combustible Dusts and Hazardous (Classified) Locations (NFPA 499-2008)**
- Static Electricity (NFPA 77-2007)
- Life Safety Code (NFPA 101-2009)
- Selection, Care, Use and Maintenance of Flame-Resistant Garments for Protection of Personnel Against Flash Fire (NFPA 2113-2007)
- ACGIH Ventilation Manual (26<sup>th</sup> Edition)
- Prevention and Mitigation of Combustible Dust Explosion and Fire (FM Data Sheet 7-76)

# Combustible Dust Inspections

- Average cost to abate (fix) all IOSHA combustible dust citations
  - **\$337,500 per combustible dust inspection**
- Field Operations Manual (FOM)
  - If an employer's level of compliance lags significantly behind that of its industry, allegations of economic infeasibility will not be accepted
  - Federal OSHA is allowed to use State Plan OSHA citations to prove Willful (Knowing) citations for multi-state employers



# **LACK OF EXPLOSION PROTECTION**

Deflagration Venting, Deflagration Suppression Systems, Oxidant Concentration Reduction, Deflagration Pressure Containment, Dilution with Noncombustible Dust  
(Section 7.1.2.1 of NFPA 654-2006)



HOFFMAN

1000





If you used deflagration venting, how would you vent this structure and where would the vent(s) go?









Abort Gate

The image shows a large, horizontal, silver-colored metal duct system. A blue metal gate, labeled 'Abort Gate', is partially open, revealing a grid of white circular components. To the right, a yellow cylindrical component, labeled 'Backdraft Damper', is attached to the duct. A white arrow points to this damper. The background is a light, overcast sky.

Backdraft Damper



# Combustible Dust is Required to be Conveyed to a Dust Collector or Dust Collection System



# Enclosureless Dust Collector

No Explosion  
Protection Required



**DO DUST COLLECTORS  
HAVE TO BE LOCATED  
OUTSIDE?**

A photograph of a stainless steel dust collector barrel. The barrel is cylindrical and has a lid on top. A white PVC pipe is connected to the side of the barrel, leading to a larger metal pipe that curves upwards. The barrel is situated in a room with a corrugated metal wall and a concrete floor. The lid of the barrel has several white PVC pipes protruding from it. The text "BLENDER DUST COLECTOR" is printed on a white label on the side of the barrel.

**BLENDER DUST  
COLECTOR**



**⚠ DANGER ⚠**  
EXPLOSION PANEL  
DO NOT STAND OR WORK  
IN FRONT OF THIS PANEL  
WHILE EQUIPMENT IS  
IN SERVICE



BUILDING DUST  
COLLECTOR

# Explosion Suppression Systems



# **IMPROPER DEFLAGRATION VENTING**

Standard on Explosion Protection by  
Deflagration Venting (NFPA 68-2007)

# Fireball Dimensions Formula

- Section 8.8.2 of NFPA 68-2007 (Page 23)
- $D = K (V / n)^{1/3}$ 
  - D = Axial Distance (front) from the Vent (m)
  - K = Flame Length Factor
    - K = 10 for Metal Dusts, K = 8 for Chemical and Agricultural Dusts
  - V = Volume of Vented Enclosure (m<sup>3</sup>)
  - n = Number of Evenly Distributed Vents
- Formula only valid for certain conditions (See Section 8.8.5 of NFPA 68-2007)



# Explosion Venting



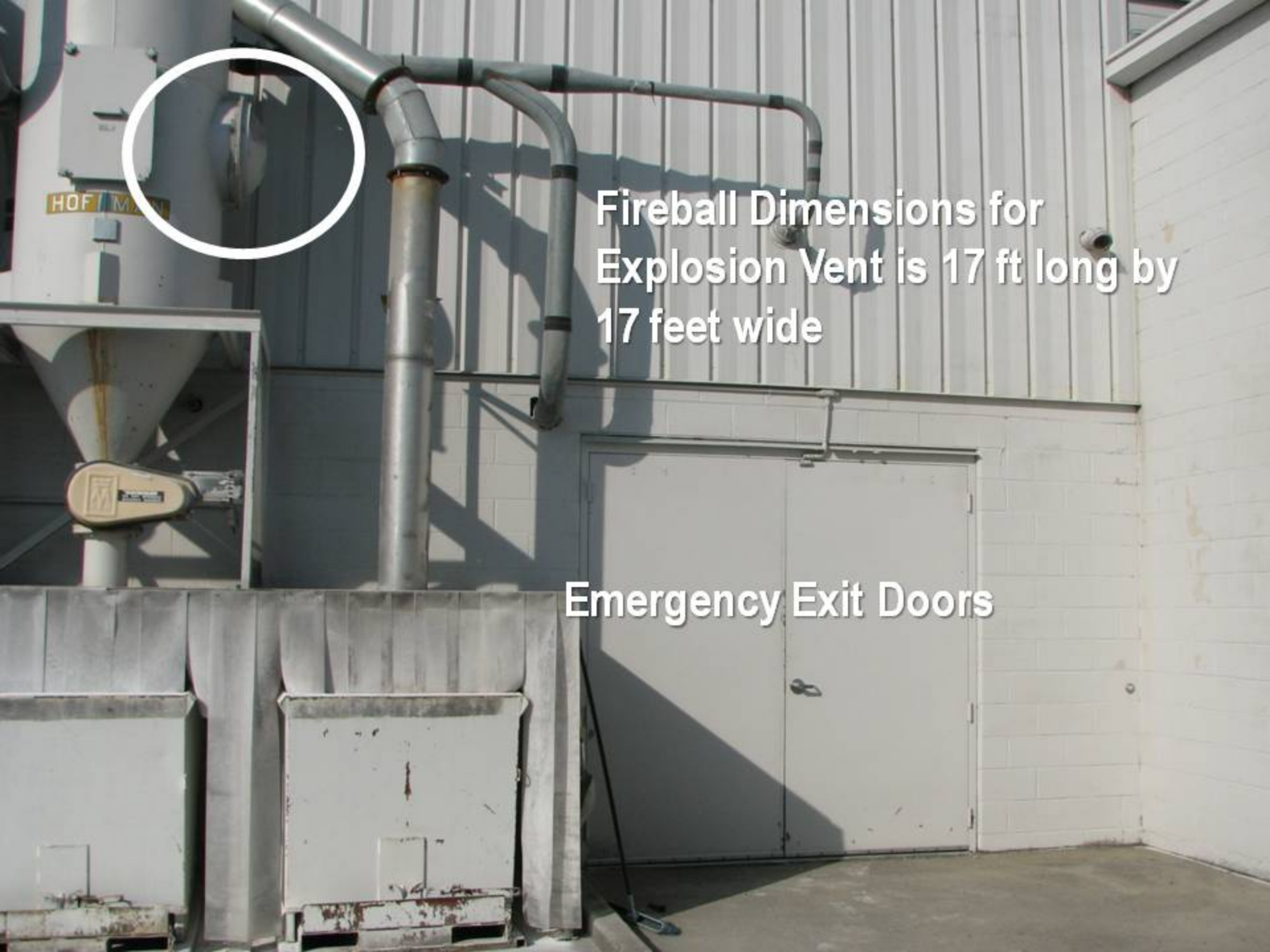
**Is the explosion venting on this dust collector designed properly and in compliance?**

# Explosion Venting

- Just because a dust collector is equipped with explosion venting **DOES NOT** mean that it is vented correctly
- The employer must prove that the explosion venting is designed properly
  - Must make sure that the pressure needed to release the vent panel ( $P_{stat}$ ) is small compared with the maximum tolerable explosion pressure ( $P_{red}$ )
  - Although the employer is not required to test their dust, the  $K_{st}$  value is required to determine proper explosion vent size
- If the dust collector is equipped with explosion venting and the employer cannot prove that the explosion venting is designed properly, then a General Duty citation will be issued
  - NFPA 68 will be used as a method of abatement

# Explosion Venting





Fireball Dimensions for  
Explosion Vent is 17 ft long by  
17 feet wide

Emergency Exit Doors

# Explosion Venting



Donaldson  
Torit

Emergency Exit Doors

Fireball Dimensions for Each  
Explosion Vent is 21 ft high by 21  
feet wide



**Fireball Dimensions for Each  
Explosion Vent is 46 ft high by 46  
feet wide**

Not allowed to have more than 1/32<sup>nd</sup> of an inch on the floor or other surfaces  
(NFPA 654-2006)

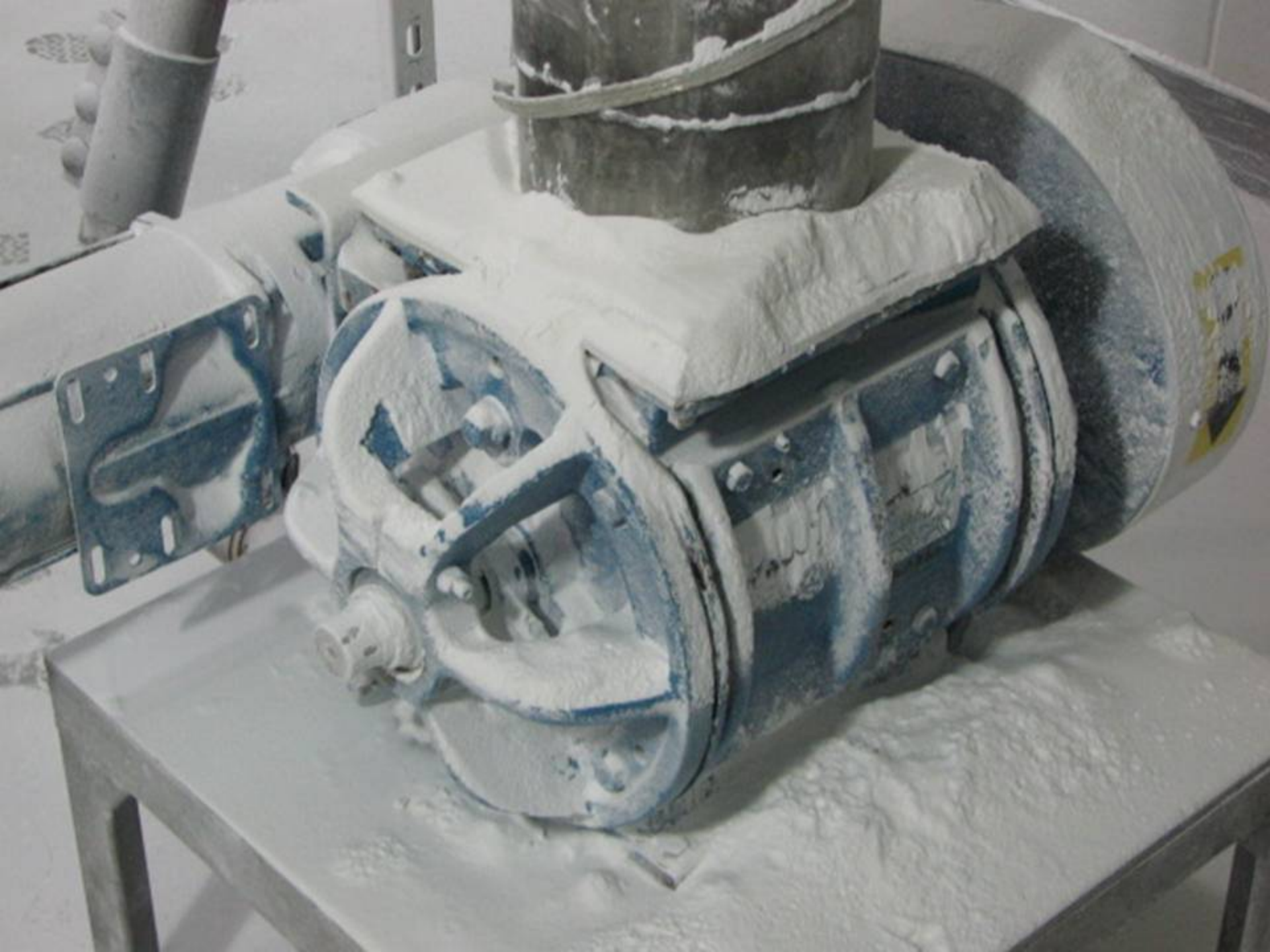
# **IMPROPER HOUSEKEEPING**

Moderate or Dense Dust Cloud or a Dust Layer Greater Than 1/8 of an inch is Class II, Division 1 location (NFPA 499-2008)



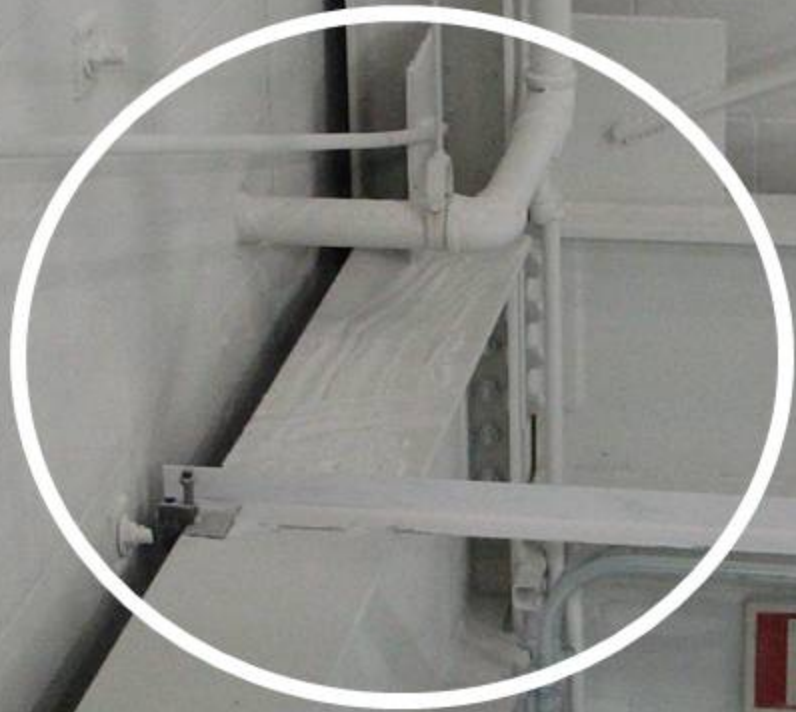












**EXIT**









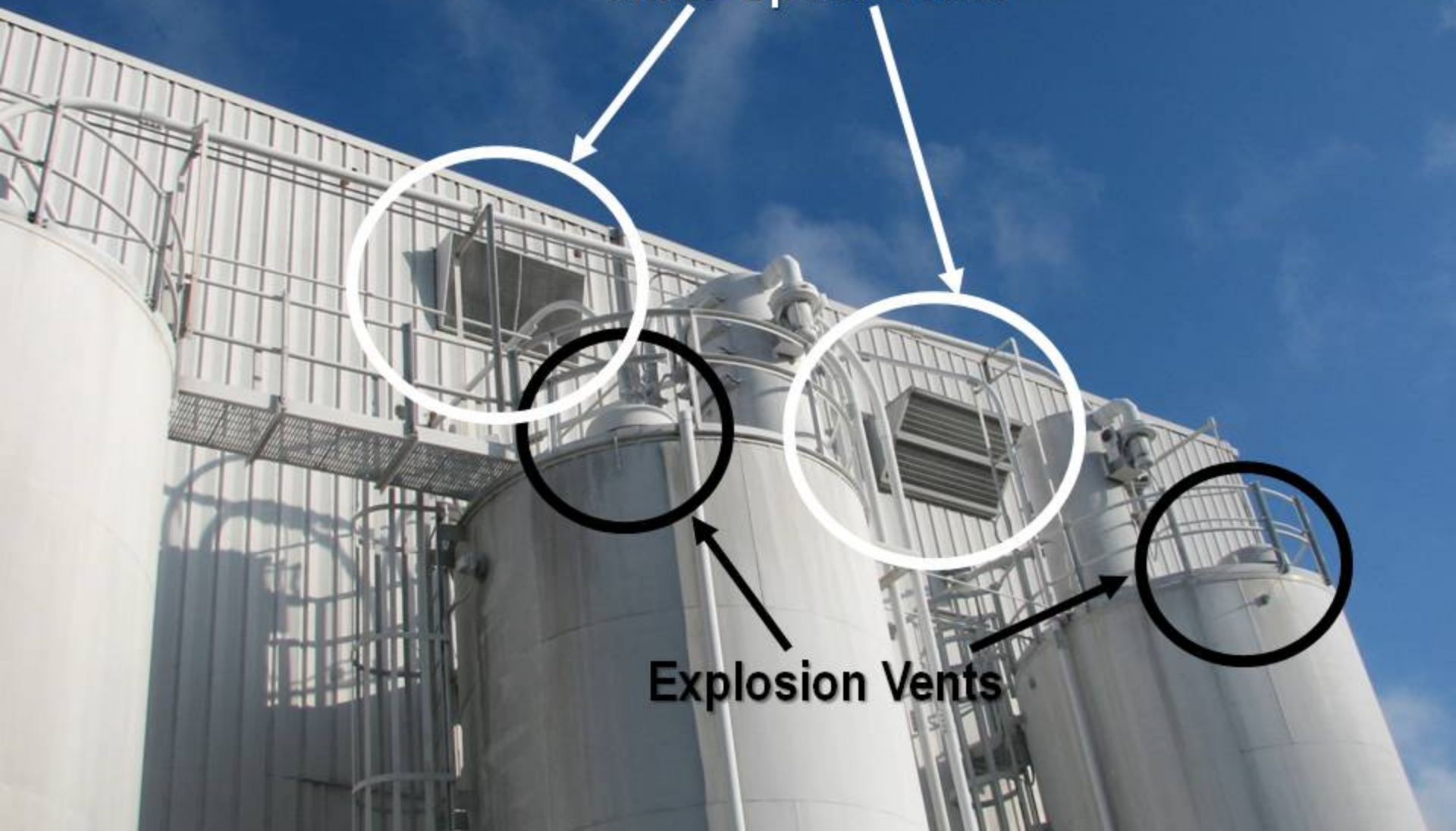




# **VENTILATION**

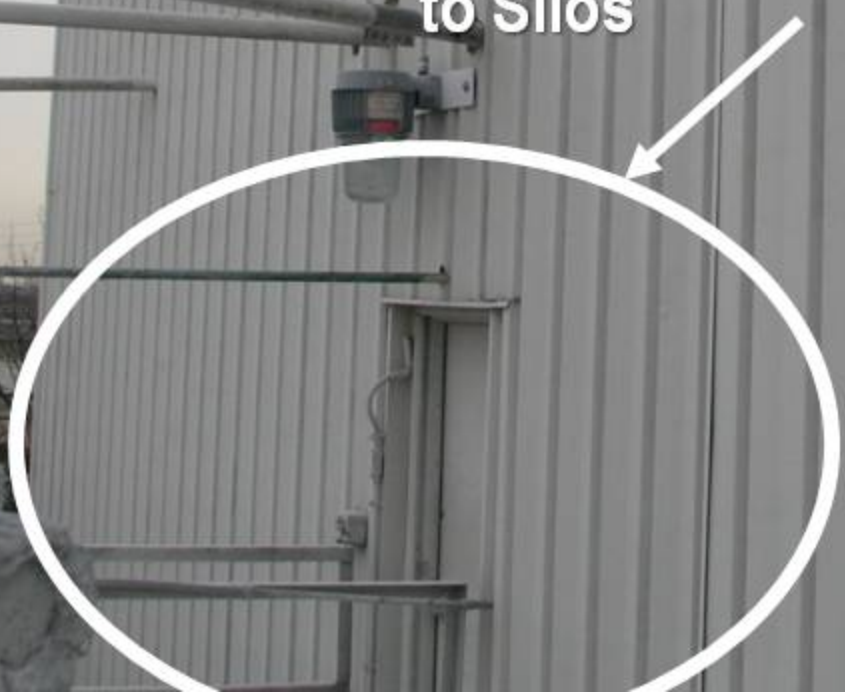
Especially Look at the Make-Up (Recycled) Air  
System for Facility

**Make-Up Air Vents**



**Explosion Vents**

**Emergency Exit Door Leading  
to Silos**





**Make-Up (Return) Air System**



# **SOURCES OF IGNITION**

Especially Look at Classification of Electrical  
Equipment and Installations









**REDDY HEATER**

PRO 155

155,000 BTU





# What Else Does OSHA Look For?

- Use of compressed air to clean or blow off surfaces with settled fugitive combustible dust emissions
- HazCom Training
- Material Safety Data Sheets (MSDSs)
- Improper vacuums used to clean-up combustible dust
- Improperly rated forklifts used in areas where combustible dust is generated and/or settled
- Unapproved exhaust fans and motors used in ventilation systems
- Emergency Action Plans and Fire Prevention Plans
- Fire Extinguishers
- Personal Protective Equipment (PPE)
  - Flame Resistant, 100% Cotton (All Natural Fibers)

FIRE  
EXTINGUISHER

APV



# QUESTIONS



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