Emerging Issues in the Oil and Gas Industry

Rocky Mountain EHS Peer Group Meeting

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Denver, CO

by

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Emerging Issues

- Tank Gauging
- Production Water Hazards
- Silica

Tank Gauging

- From 2010-2014, there have been fatalities associated with tank gauging, sampling, and fluid transfer activities at oil and gas well sites where the inhalation of volatile petroleum hydrocarbons is a possible contributing factor.
  - 9 Fatalities – all occurred at crude oil (production) tanks.
  - North Dakota, Colorado, Oklahoma, Texas, and Montana.
  - 4 fatalities occurred during tank gauging.

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Tank Gauging (cont.)

- 5 fatalities occurred during sampling by pumpers/truckers.
- All employees who were working alone or not being observed.
- Confined space, fires/explosions, and documented H2S were excluded.

Tank Gauging (cont.)

- When hatches on production tanks are opened by a worker, a plume of hydrocarbon gases and vapors can be rapidly released due to the internal pressure present in the tank.
  - Volatile Organic Compounds (VOCs)
    - Benzene
    - Ethane
    - Propane
    - Butane

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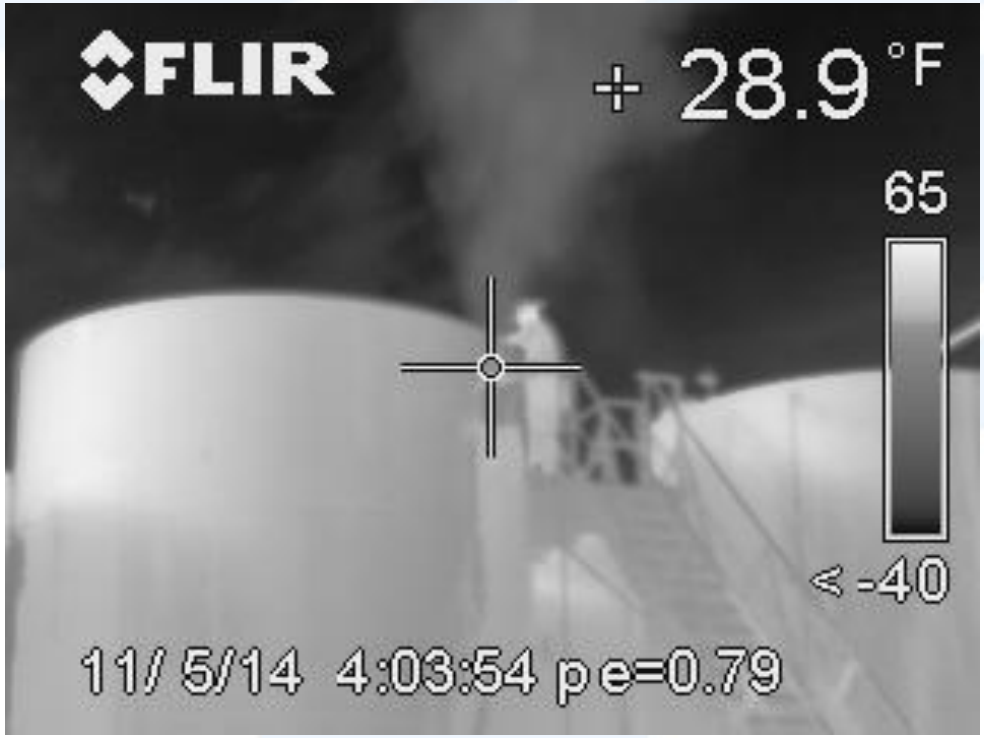
Tank Gauging (cont.)

Tank Gauging (cont.)

Tank Gauging (cont.)

Tank Gauging (cont.)

- Vapor Emissions
  - Infrared photo demonstrating vapor emissions upon opening tank hatch.



Tank Gauging (cont.)

- Plume is emitted after hatch is opened.

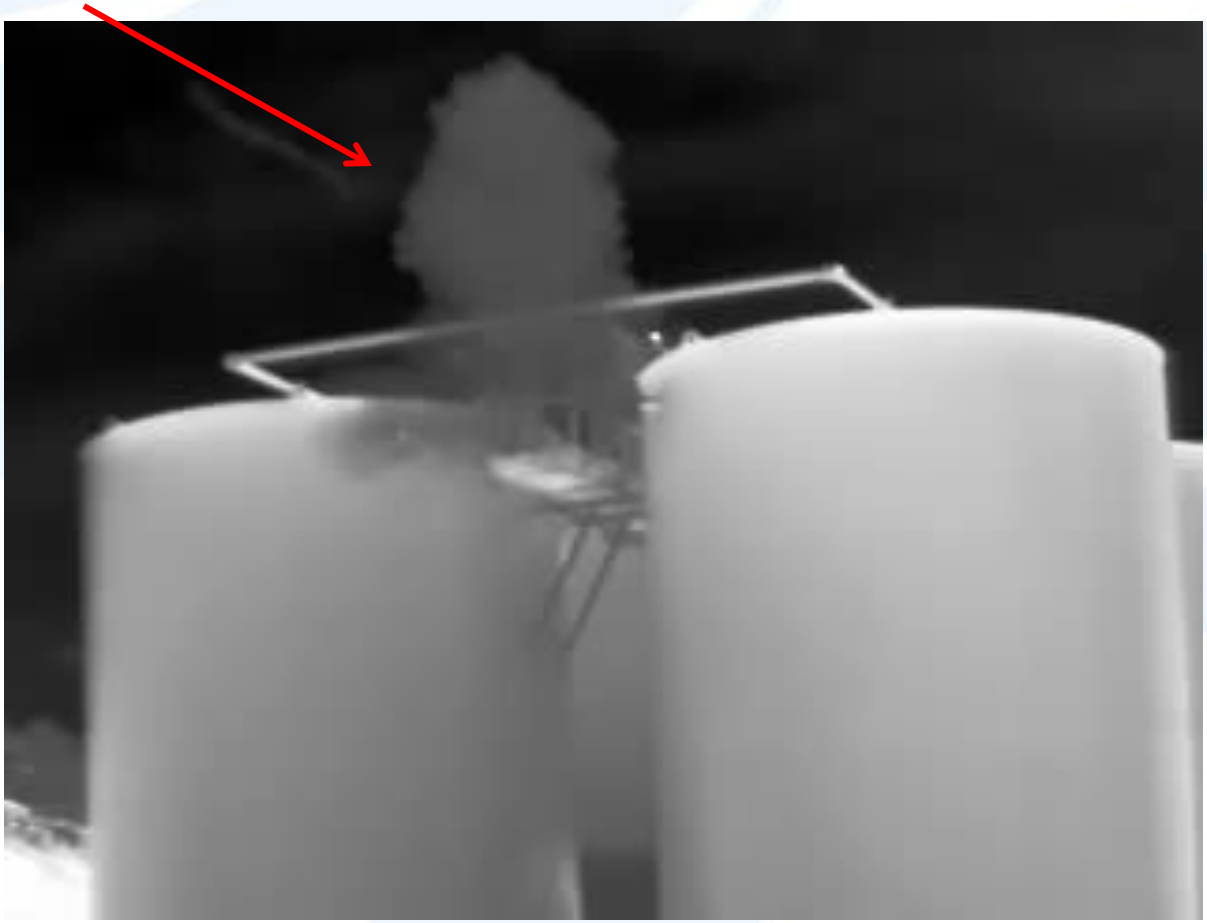


Photo courtesy of NIOSH

Tank Gauging (cont.)

- Flow Back Operations

1.2 ppm Benzene at
54 inches above hatch

149 ppm Benzene at 18 inches above hatch

Photo courtesy of NIOSH

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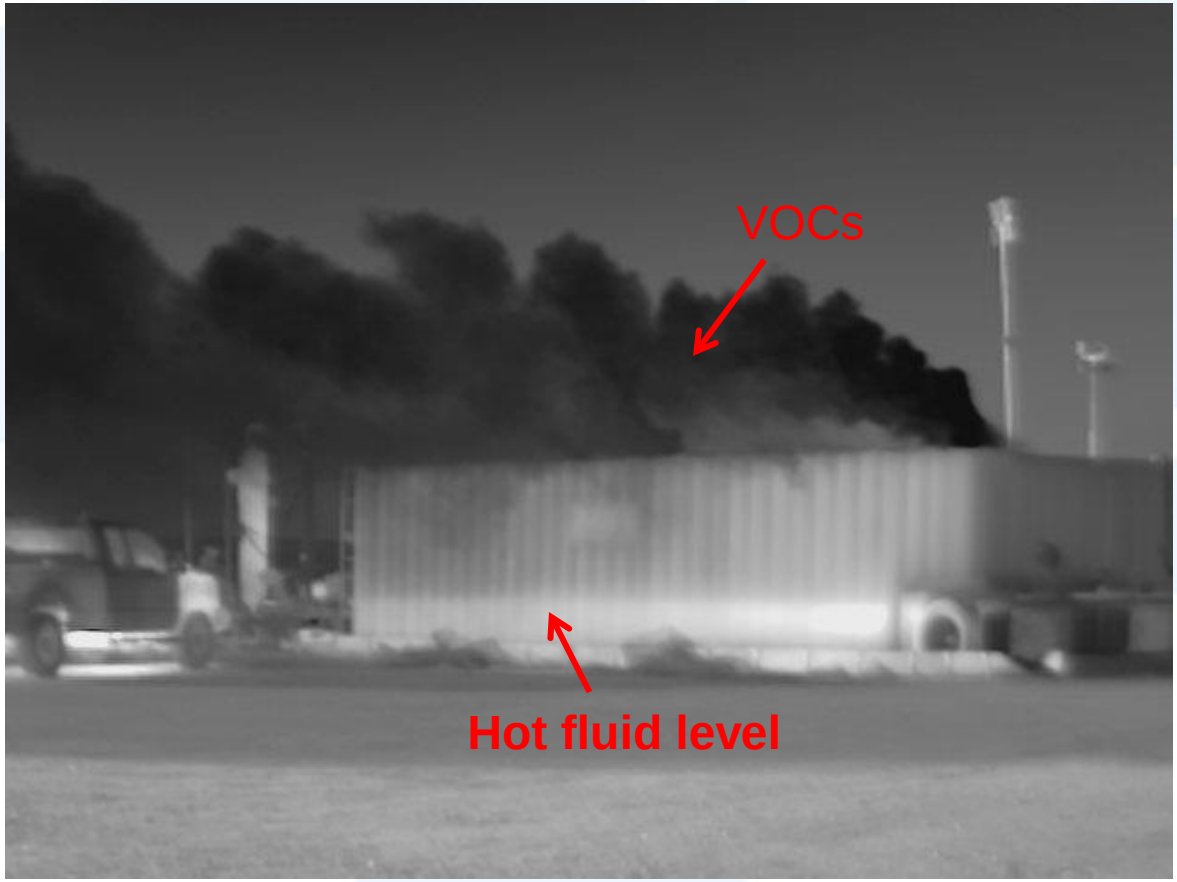
Tank Gauging (cont.)

- Flow Back Operations



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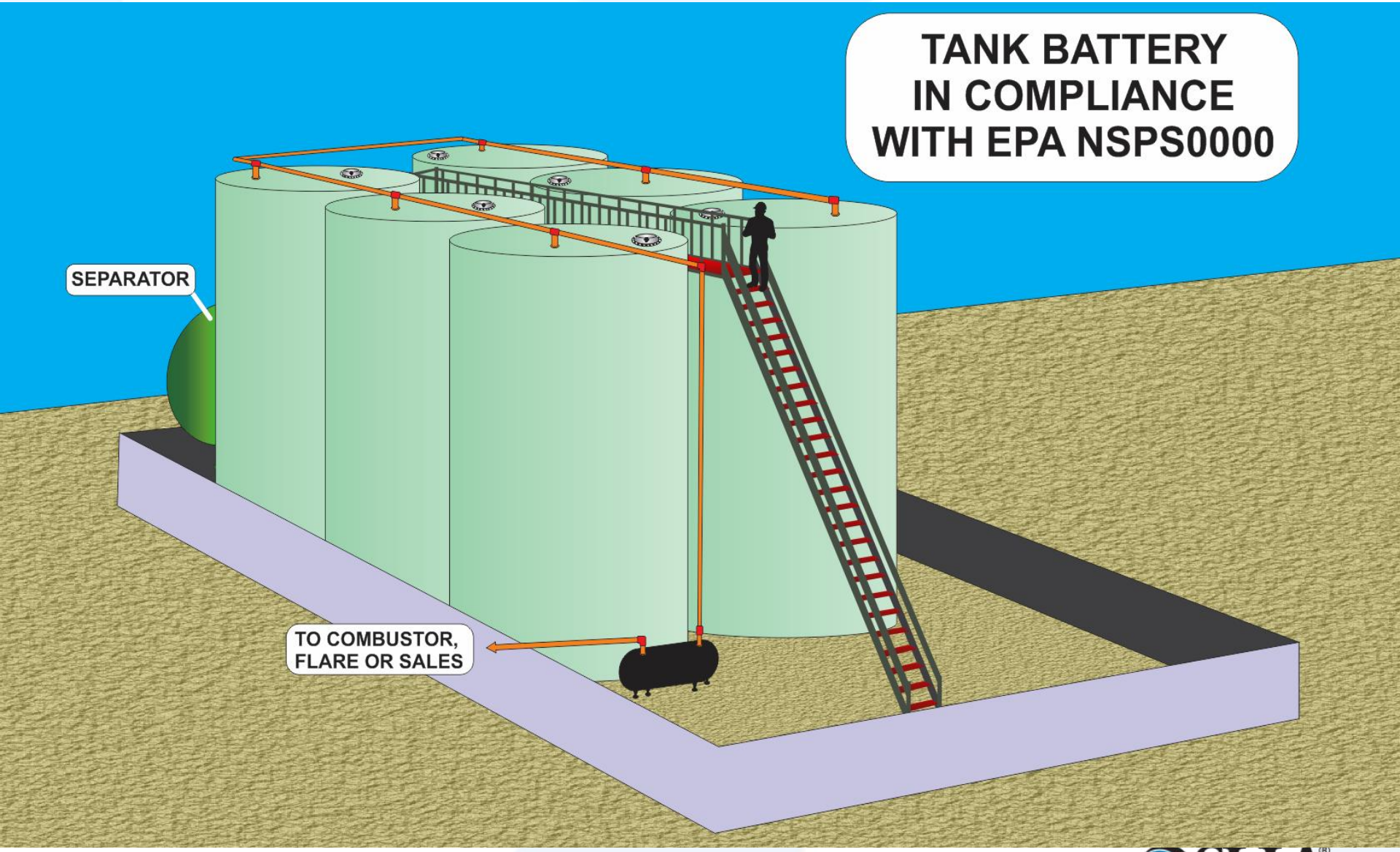

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NSPS OOOO Controls

- Control emissions from headspace by tightly sealing tanks
- Headspace in multiple tanks in a battery are connected
- Pressure (4-12 oz/inch^2) is required for burner/flare/VRU operation,
- Headspace typically excludes oxygen for flammability control, rich atmosphere can be result of vapor pressure of tank contents or “sweep” gas (typically methane)

Slide courtesy of NIOSH

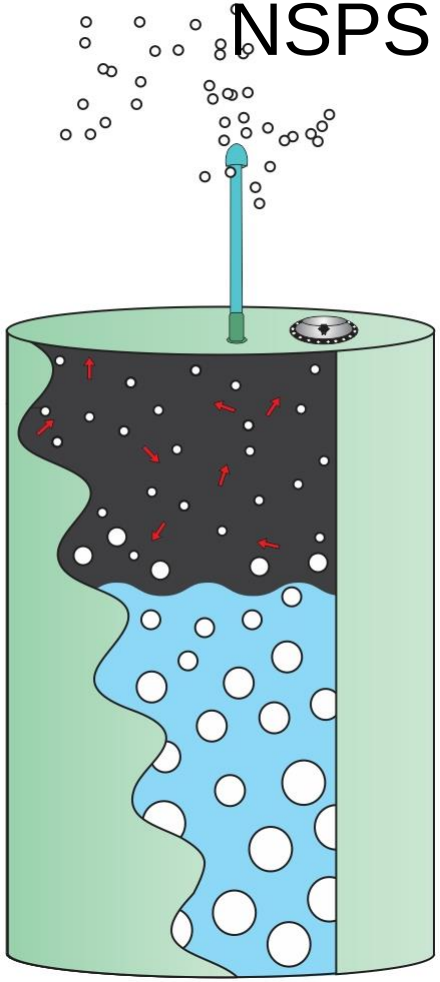
Lowering Release of Vapor from Tanks

Many environmental benefits

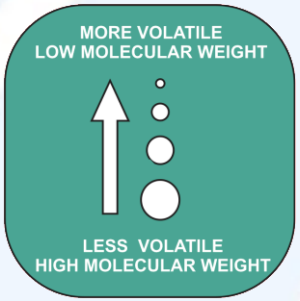
- Greenhouse gas emission reduction
- Reduced VOC and ground level ozone
- Reduction in predicted cancers and non-cancer endpoints in human/community risk assessments
- **No occupational safety and health consideration**

Slide courtesy of NIOSH

Behavior of Production Fluid Storage Vessels without NSPS 0000 Controls (pre-2012)



Tank is continuously vented to the atmosphere. Gases and vapors in tank are in equilibrium with outside air. No significant pressure on the tank.



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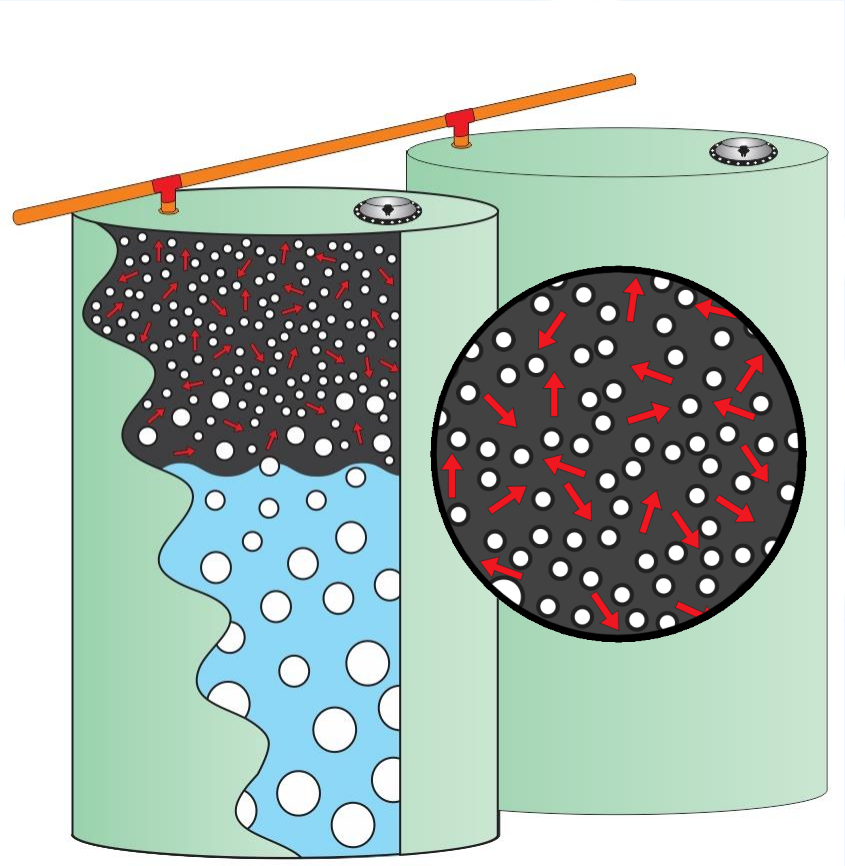
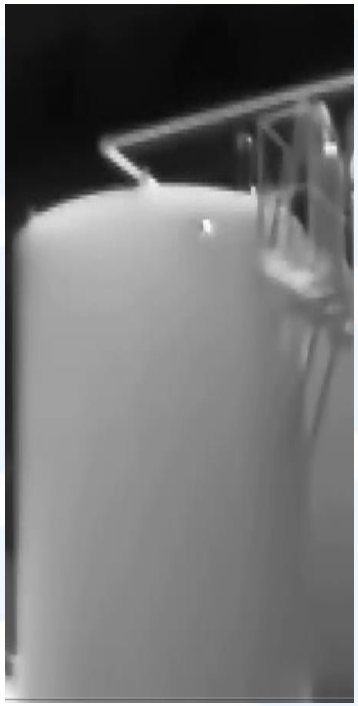
Behavior of Production Fluid Storage Vessels with NSPS 0000 Controls (post- 2012)



Hatch is closed. No visible emissions, greater than 95% VOCs produced are controlled. Gases and vapors in tank are in equilibrium with gas and vapors in the liquid hydrocarbon. The different gases and vapors are exerting pressure on the container.



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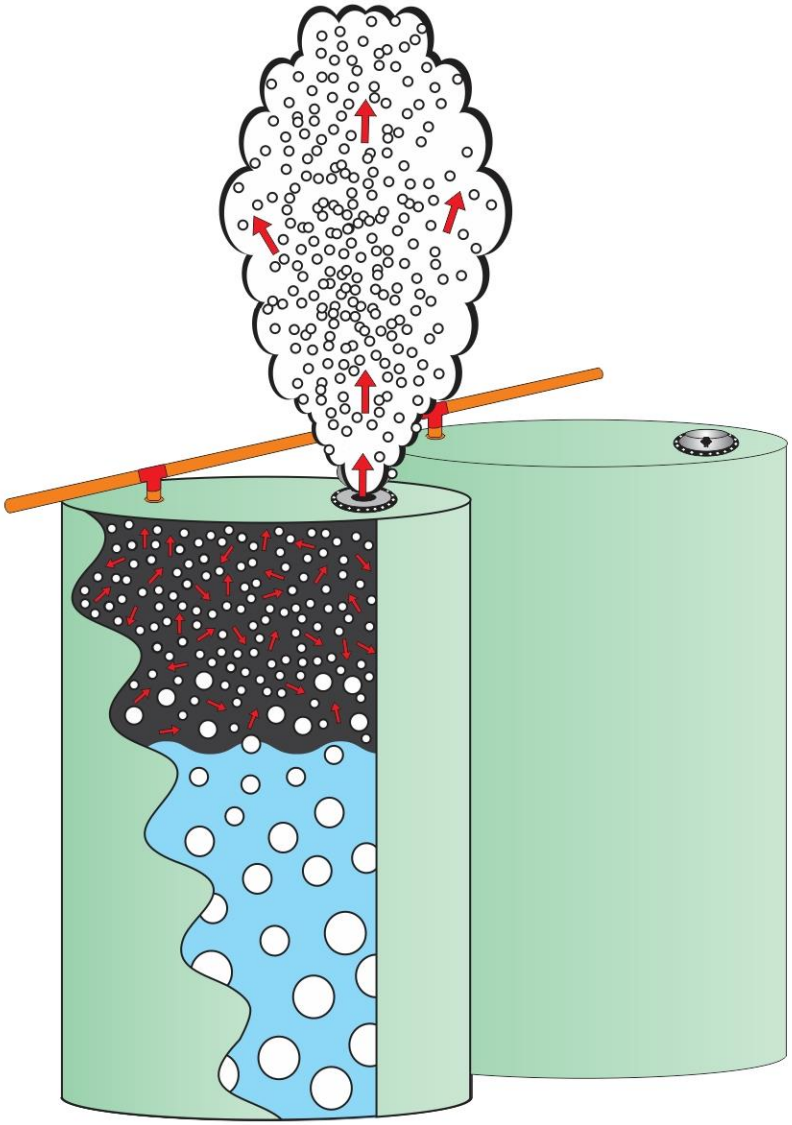
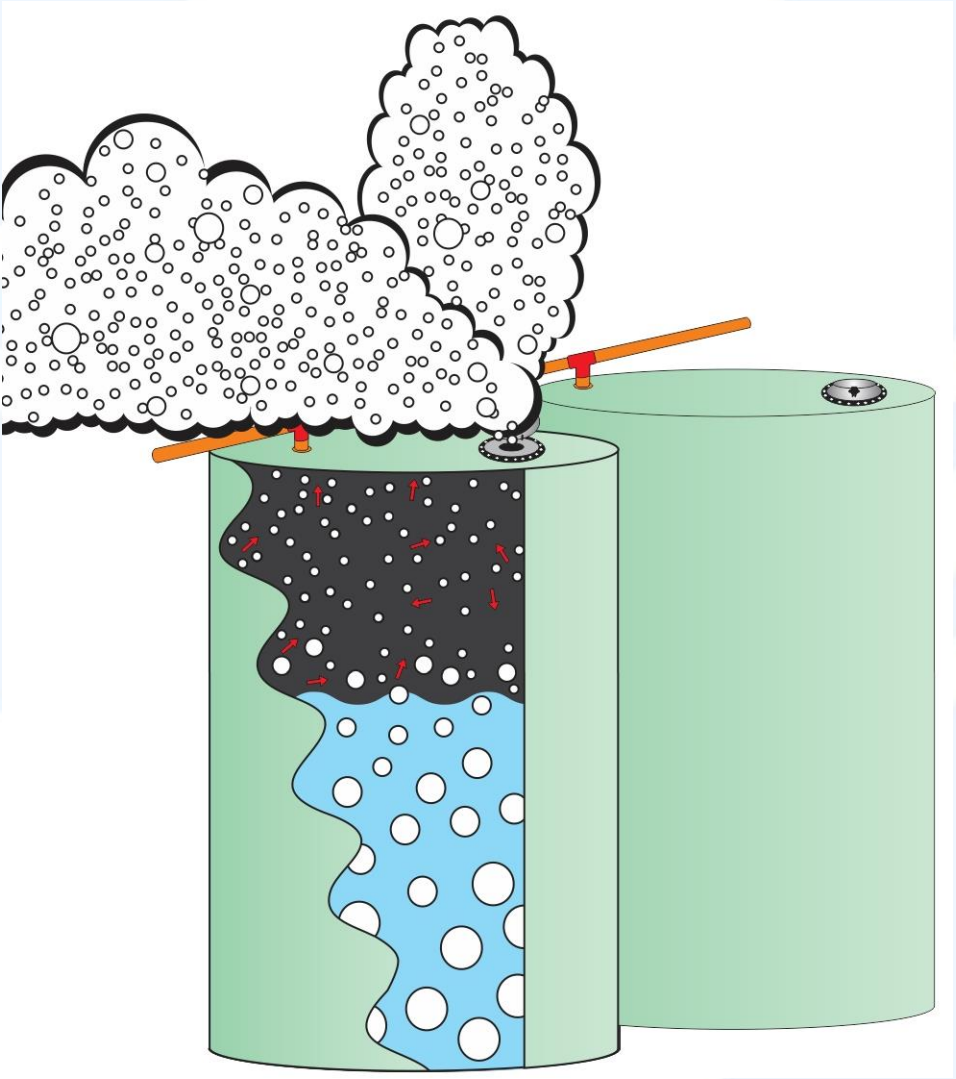


Slide courtesy of NIOSH

Hatch is opened. A large volume of gases (mostly propane and butane) rush out of the hatch very quickly. The “cloud” can displace oxygen in the immediate work area and presents an immediate asphyxiation hazard.



As hatch remains open, heavier hydrocarbons in the tank (pentane, hexane, heptane, BTEX) will evaporate and leave the tank and enter the workspace. Rate of flow is still high and these gases and vapors may be present at toxic and flammable concentrations.

Slide courtesy of NIOSH

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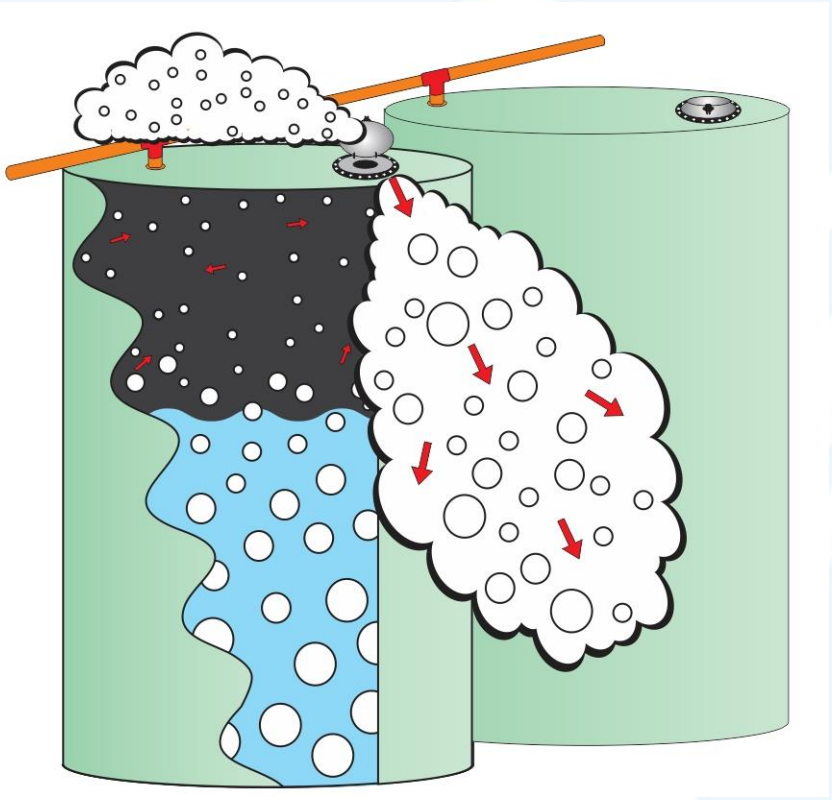

Hatch remains open. Gases and vapors in tank are approaching equilibrium with the environment and the rate of emission slows down significantly. Heavy gas and vapors drop toward the ground.

Slide courtesy of NIOSH

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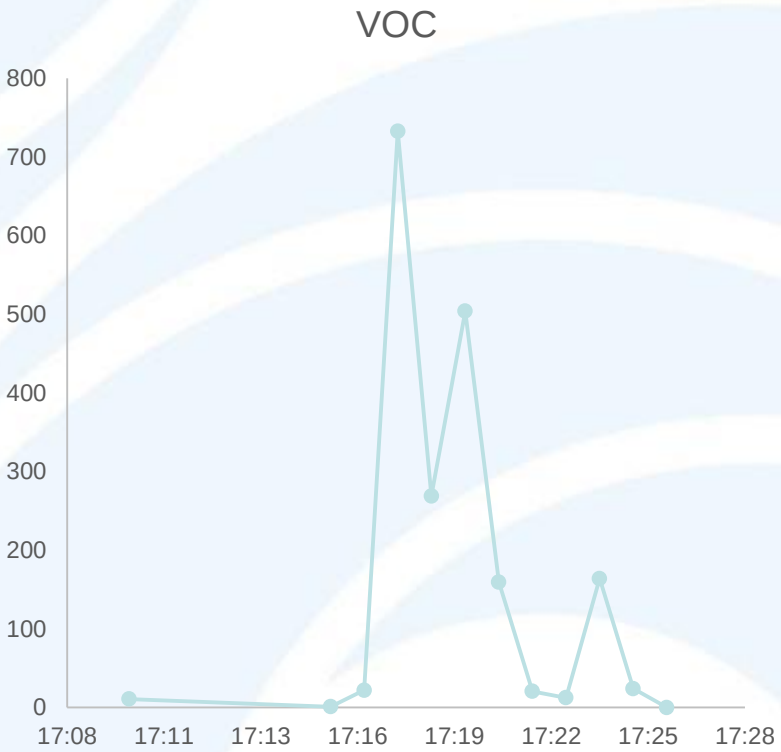
Personal Breathing Zone VOC concentration (isobutylene equivalents) vs. time for workers gauging tanks

Without NSPS 0000 Controls (pre-2012)

With NSPS 0000 Controls (Post-2012)



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Tank Gauging (cont.)

- Hazards to Workers
  - Asphyxiation – Oxygen deficient atmosphere
  - Narcotic Effects Resulting in
    - Disorientation
    - Dizziness
    - Light-headedness
    - Cardiac arrhythmia (irregular heartbeat),
    - Hypoxia (a state of insufficient oxygen supply)
    - Respiratory depression (reduced breathing rate and inadequate ventilation of the lungs)
  - Explosive

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Tank Gauging (cont.)

- Flammability Hazards

Tank Gauging (cont.)

- Recommendations
  - Implement alternative tank gauging
    - Remote Gauging
    - Closed Loop System
    - Auto Gauging
    - Sight Glasses/Gauges
    - Remote Venting
    - Where remote gauging is not feasible or as an interim measure, establish administrative controls that reduce the number of times throughout a shift a worker is required to manually gauge tanks.

Tank Gauging (cont.)

- Employers must
  - Conduct Exposure and Hazard Assessments at worksites
    - Respiratory Protection
    - Personal Protective Equipment (PPE)
    - Monitoring Devices
      - Multi-gas meters or other toxic gas meters

Tank Gauging (cont.)

- Employers must
  - Train Employees on
    - Hazard Assessment
    - Hazard Communications
    - Standard Operating Procedures for Tank Gauging
    - Proper use of PPE & Respiratory
    - Emergency Response Plan
    - Lone Worker Policy
    - Monitoring Devices
      - Toxic gas or Multi-gas meter for O2, H2S, LEL, CO
    - Potential Ignition Sources
      - Static, Cell phone, Open flame, sparks from tools
      - Ensure proper grounding/bonding

Tank Gauging (cont.)

- OSHA and NIOSH are currently working with industry partners to further evaluate the magnitude of these hazards as well as evaluate the effectiveness of controls such as remote gauging systems.

Tank Gauging (cont.)

- Working with the National STEPS Network

Tank Gauging (cont.)

- NIOSH Websites:
  - http://www.cdc.gov/niosh/topics/FOG/
- OSHA and NIOSH will be coming out with a joint Hazard Alert within several months.
- Trying to meet with BLM to discuss their requirement for manual tank gauging.

Production Water

- It is referred to as;
  - Brine
  - Salt Water
  - Waste Water
  - Produced Water
- Production water still has small amount of crude oil and gas present in production tanks and transportation tanker trucks.
- Just in 2014, there have been over 7 fatalities and incidents of explosions/fires relating to tankers and production tanks.

Production Water (cont.)

Production Water (cont.)

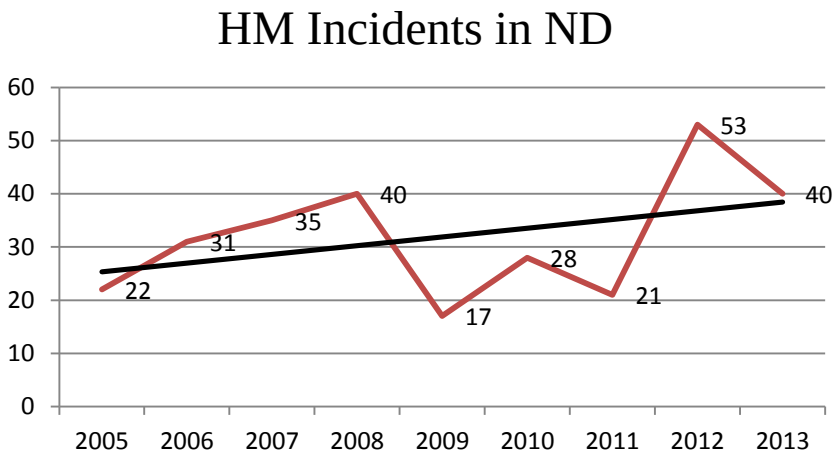
- Employee killed from explosion from spot welding a pinhole leak on a sight glass stem on a tanker truck.

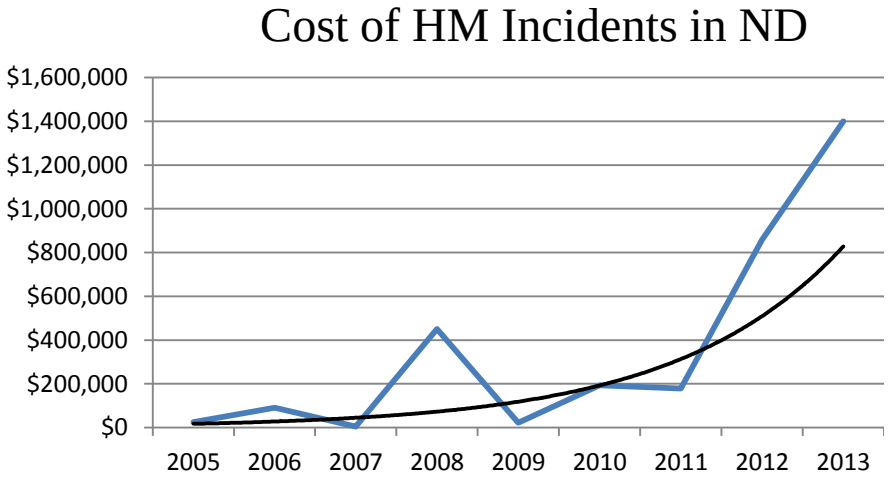
Production Water (cont.)

- Major Contributing Causes
  - Not recognizing the hazard
  - Not cleaning or thoroughly cleaning out tank before beginning work
  - No monitoring
  - No Venting
  - No Hotwork permit
  - Have Supervisors sign off on permit/audit work procedures

Estimated HM Stats for North Dakota

- Over 400 registered HM Carriers and/or Shippers in North Dakota for 2014-2017 registration cycle. (Approximately 13% are in the Fargo area)
- There is a linear growth of HM incident and an exponential growth of HM incident cost.
- There were 287 HM incidents that took place over an eight (8) year period which averages to be 36 HM incidents per year.
- What occurred between 2011 and 2012 that caused the spike in HM incidents?





Data obtain from: https://hip.phmsa.dot.gov

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HAZARD ALERT

Worker Exposure to Silica during Hydraulic Fracturing

The National Institute for Occupational Safety and Health (NIOSH) identified exposure to airborne silica as a health hazard to workers conducting some hydraulic fracturing operations during recent field studies.

Introduction

Hydraulic fracturing or "fracking" is a process used to "stimulate" well production in the oil and gas industry. It is not a new process, but its use has increased significantly in the last 10 years because of new horizontal drilling and multi-stage fracking (or "completions") technologies that improve access to natural gas and oil deposits. It involves pumping large volumes of water and sand into a well at high pressure to fracture shale and other tight formations, allowing oil and gas to flow into the well.

NIOSH's recent field studies show that workers may be exposed to dust with high levels of respirable crystalline silica (called "silica" in this Hazard Alert) during hydraulic fracturing.

This Hazard Alert discusses the health hazards associated with hydraulic fracturing and focuses on worker exposures to silica in the air. It covers the health effects of breathing silica, recommends ways to protect workers, and describes how OSHA and NIOSH can help. Workers and employers need to be aware of the hazard that silica dust poses. Employers must ensure that workers are properly protected from exposure to silica. This Hazard Alert also provides a brief summary of other health and safety hazards to workers conducting hydraulic fracturing activities.

Crystalline silica is a common mineral found in the earth's crust. It occurs primarily as quartz and is a major component of the sand, clay and stone materials used to make every day products such as concrete, brick and glass.

Respirable crystalline silica is the portion of crystalline silica that is small enough to enter the gas-exchange regions of the lungs if inhaled; this includes particles with aerodynamic diameters less than approximately 10 micrometers (μm).

Photo credit: NIOSH

Silica dust cloud by worker delivering sand from sand mover to transfer belt.

OSHA and **NIOSH** have been investigating worker safety and health hazards in oil and gas extraction, including chemical exposures during hydraulic fracturing operations.

OSHA has jurisdiction over the safety and health of workers, including workers involved in upstream oil and gas operations. The General Duty Clause of the Occupational Safety and Health (OSH) Act and OSHA's General Industry Standards (29 CFR 1910) apply to the upstream industry. As part of the enforcement of these regulations, five OSHA regions located in areas of significant upstream activities use national, regional, and local emphasis programs to inspect oilfield worksites, including those that may have ongoing hydraulic fracturing operations.

NIOSH made safety and health in the oil and gas extraction industry a priority focus area in 2005 by creating the National Occupational Research Agenda (NORA) Oil and Gas Extraction Council, which includes OSHA and industry leaders in a cooperative effort to address occupational safety and health issues. To address an existing lack of information on occupational dust and chemical exposures associated with hydraulic fracturing, NIOSH established specific industry partnerships and initiated the NIOSH Field Effort to Assess Chemical Exposures to Oil and Gas Extraction Workers (http://www.cdc.gov/niosh/docs/2010-130/pdfs/2010-130.pdf). Exposure to silica during hydraulic fracturing has been the focus of the NIOSH study to date.

Thank You

Any Questions?

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