Use, Application and Limitations of Portable and Fixed Monitors

NSTEPS EMERGING ISSUES FOCUS GROUP MAY 2016

Three Basic Atmospheric Hazards

- Oxygen (deficiency and enrichment)
- Flammable gases and vapors
- Toxic contaminants

Hazardous Atmospheres*

Atmosphere that has the potential to expose entrants to the risk of death, incapacitation, impaired ability to self-rescue (e.g. escape unaided from a permit required confined space), injury, or acute illness from one or more of the following causes:

- atmospheric oxygen concentrations below 19.5 % and above 23.5 %
- flammable gas, vapor, or mist in excess of 10 % LEL
- atmospheric concentration of any substance for which a dose or OEL is published in applicable government regulations, safety data sheets (SDS), standards, or other published or internal documents and could result in responder exposure in excess of its dose or PEL;
- any other IDLH atmospheric condition

Source: API RP 98, Personal Protective Equipment Selection for Oil Spill Responders, First Edition, August 2013. Global Standards

What is IDLH

IDLH: Immediately Dangerous to Life and Health

- "The IDLH is considered a maximum concentration above which only a highly reliable breathing apparatus providing maximum worker protection was permitted"
- "the ability of a worker to escape without loss of life or irreversible health affects"
- Critical symptoms that could retard escape are:
  - Blindness
  - Unconsciousness
  - Impaired judgment

Primary Atmospheric Hazards in Oil and Gas Exploration and Production

- Oxygen
  - Deficiency = too little oxygen to support life
  - Enriched = increased fire hazard
- Flammable gases and vapors
- Hydrogen Sulfide
- Carbon Monoxide

Oxygen

There is no antidote for too little oxygen!

% Oxygen	Physiological Effect
19.5 – 16	No visible effect.
16 – 12	Increased breathing rate. Accelerated heartbeat. Impaired attention, thinking and coordination.
14 – 10	Faulty judgment and poor muscular coordination. Muscular exertion causing rapid fatigue. Intermittent respiration.
10 – 6	Nausea and vomiting. Inability to perform vigorous movement, or loss of the ability to move. Unconsciousness, followed by death.
Below 6	Difficulty breathing. Convulsive movements. Death in minutes.

Flammable Gases and Vapors

- Flash Point
  - The minimum temperature of a liquid at which a spark or flame can cause an instantaneous flash in the vapor the liquid forms with air
  - As flash points drop, fire hazard increases
- Flammability Limits
  - Lower Explosive Limit (LEL) – the lowest concentration of a gas or a vapor where an ignition source can produce a flash of fire
  - Upper Explosive Limit (UEL) - the highest concentration of a gas or a vapor where an ignition source can produce a flash of fire

Between the LEL and the UEL
the mixture is said to be *explosive* or *flammable*.

Hydrogen Sulfide

- Hydrogen Sulfide or sour gas (H_2S) is a flammable, colorless gas that is toxic at extremely low concentrations.
- It smells like "rotten eggs" at low concentrations and causes you to quickly lose your sense of smell
- It is heavier than air, and may accumulate in low-lying areas
- Many production basins where H_2S is found have been identified, but pockets of the gas can occur anywhere
- All oil and gas sites should be classified according to areas of potential and/or actual exposure to H_2S, The four hazard levels are:
  - No Hazard Condition
  - API Condition I - Low Hazard
  - API Condition II - Medium Hazard
  - API Condition III - High Hazard

Carbon Monoxide

Carbon monoxide (CO) is a toxic gas resulting from the incomplete burning of fuels containing carbon; sources of CO at oil and gas sites may be heater treaters, engines of all kinds and flares/combustors

- CO is a colorless, odorless, toxic gas which interferes with the oxygen-carrying capacity of blood
- CO is non-irritating and can overcome persons without warning
- Effects of CO poisoning
  - Severe carbon monoxide poisoning causes neurological damage, illness, coma and death
- Symptoms of CO poisoning
  - Headaches, dizziness and drowsiness
  - Nausea, vomiting, tightness across the chest

Things that make you go Hmmm…

- 20 year old male flow tester found unresponsive on a well pad site face down in the upper hatch of a crude oil storage tank
- The victim was gauging the tank
- **There was no H2S exposure**
- ***(may or may not have been an H2S monitor)***

Things that make you go Hmmm…

- A truck driver pumping and hauling crude oil from a tank battery was found slumped over and non responsive
- He appeared to have been measuring the volume of liquid from the top of the tank battery
- **His H2S monitor did not alarm**

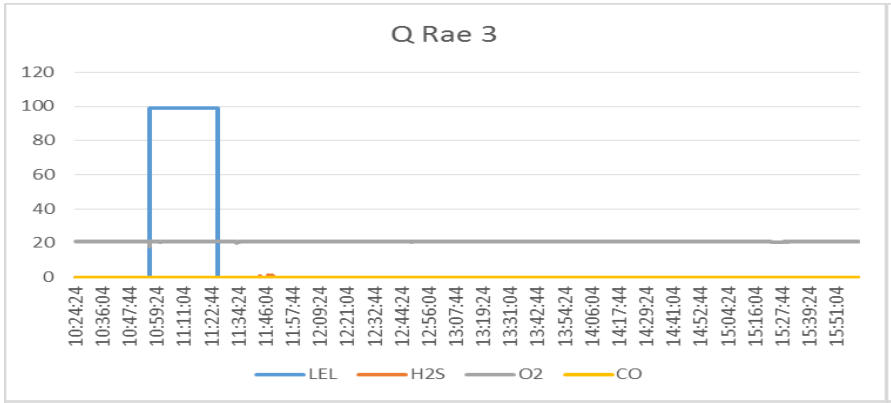
Things that make you go Hmmm…

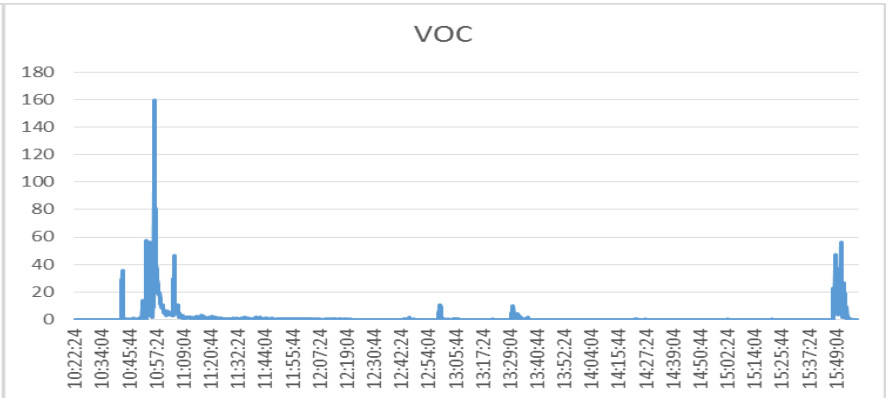
- 39 year old truck driver was transferring crude oil from a tank battery
- A pumper showed up and found the victim slumped over the railing at the top of the tank battery
- He was wearing an H2S monitor
- **There was no H2S or hydrocarbons detected in the bloodstream during the autopsy**

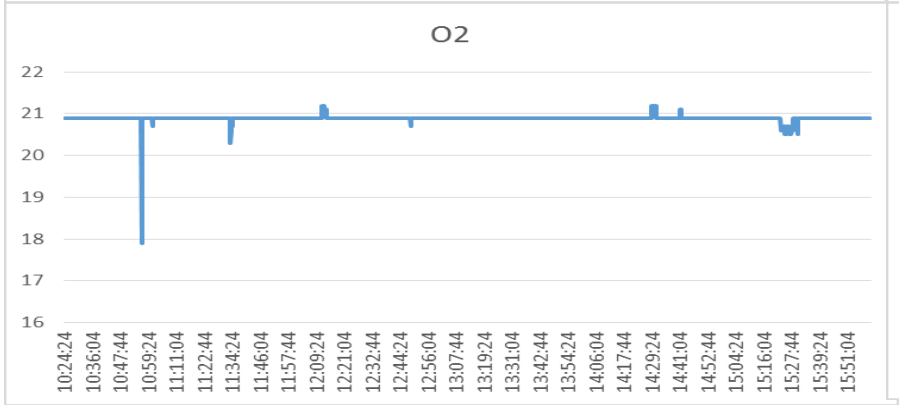
Things that make you go Hmmm…

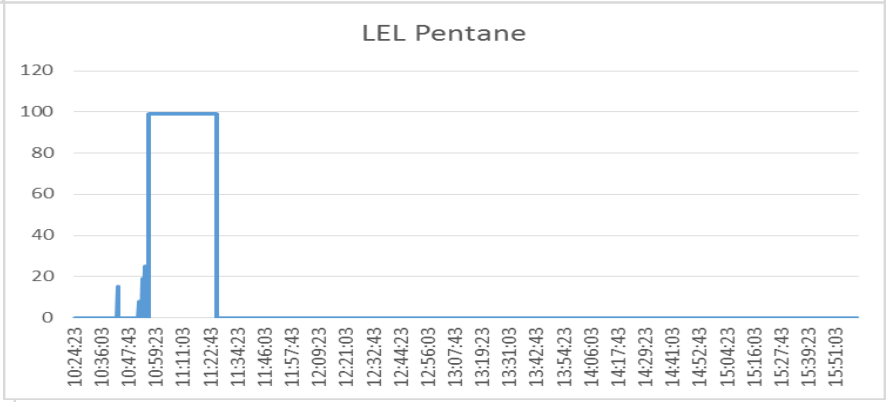
- A 59 year old oil tanker driver died while collecting crude oil samples from an open thief hatch
- **The employee was wearing a 4 gas monitor which showed an oxygen deficient atmosphere and the presence of hydrocarbons exceeding 100% of the LEL at the time of his death**

Direct Reading Instruments
Qualitative Characterization of Tank Release

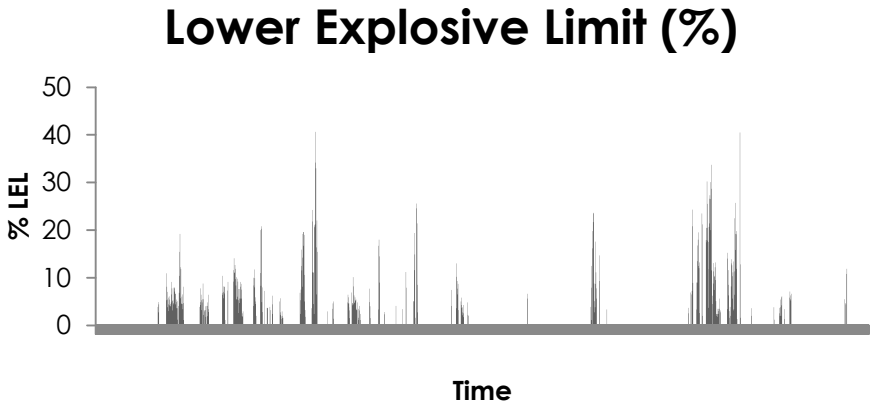








Monitor Workplace Areas



What's wrong here?

- Each case illustrates a limitation of the gas monitor or worker training
  - Limitations present risks that must be managed
  - There must be awareness of the limitations of the equipment as much as there must be awareness of the hazards

Monitor Limitations

- Must have the right detector for the application
  - H2S detector is not intended to detect combustible gases or lack of oxygen
- Cannot accurately detect combustible gases in a low oxygen environment
  - most detectors require10-15% oxygen
- Cannot detect combustible gases above the UEL
  - UEL condition doesn't mean there is no immediate fire/explosion hazard
  - monitor may initially alarm and quickly go out of alarm leading to false sense of security
- A PID probably won't help you

Monitor Limitations

- Must know the detector actually works
  - monitor must be bump tested and calibrated
- Cannot detect combustible gases above the UEL
  - UEL condition doesn't mean there is no immediate fire/explosion hazard
  - monitor may initially alarm and quickly go out of alarm leading to false sense of security

How do we manage the limitations of the equipment?

- There must be awareness of the limitations of the equipment as much as there must be awareness of the hazards
- Must develop a process that adequately evaluates and indicates the hazard while protecting the worker and accounting for the equipment
- **Training, Training, Training**