Confined Space

Rescue Technician

Session 3

Suffolk County Fire Academy

1

Session Overview

- Confined Space Examples
- Confined Space Hazards
- Air Monitoring & Ventilation
- Hazard Control
- Communications
- Psychological Effects of Confined Space
- Assessment
- Case Studies.

2

Session Objectives

- Define a permitted and non-permitted confined space and give examples
- Identify the hazards associated with confined spaces
- Explain methods to control hazards at confined space incidents
- Understand the psychological effects of confined space.

3

CONFINED SPACE EXAMPLES

4

A Confined Space Is:

- Large Enough To Bodily Enter And Work
- Limited Or Restricted Means Of Entry/Exit
- Not Designed For Continuous Occupancy
- Permit Required
  - Hazardous atmosphere
  - Engulfment hazard
  - Inward converging walls or floors
  - Any other serious safety or health hazards.

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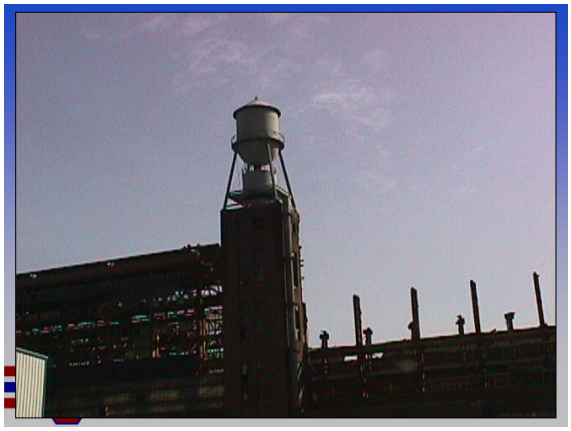

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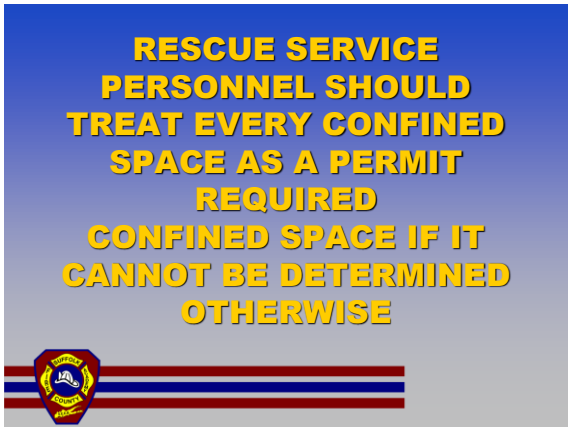
RESCUE SERVICE PERSONNEL SHOULD TREAT EVERY CONFINED SPACE AS A PERMIT REQUIRED CONFINED SPACE IF IT CANNOT BE DETERMINED OTHERWISE

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CONFINED SPACE HAZARDS

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Hazardous Atmosphere
RESPONSIBLE FOR 80% OF ALL CONFINED SPACE DEATHS

15

What Is...

- **LEL?**
  Lower Explosive Limit
- **PEL?**
  Permissible Exposure Limit
- **IDLH?**
  Immediately Dangerous To Life and Health.

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Hazardous Atmosphere

- **Oxygen - <19.5% or >23.5%**
- **Flammable Gas Vapor or Mist >10% Of The LEL**
- **Toxicity Greater Than PEL**
- **Airborne Combustible Dust At A Concentration That Meets The LEL.**

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Hazardous Atmosphere

- **Atmospheric Concentration Of Any Toxin That Could Exceed The Permissible Dose**
- **Any Other IDLH Condition.**

18

Sequence of Testing

- FIRST – Oxygen Level
- SECOND – Flammability
- THIRD – Toxins.

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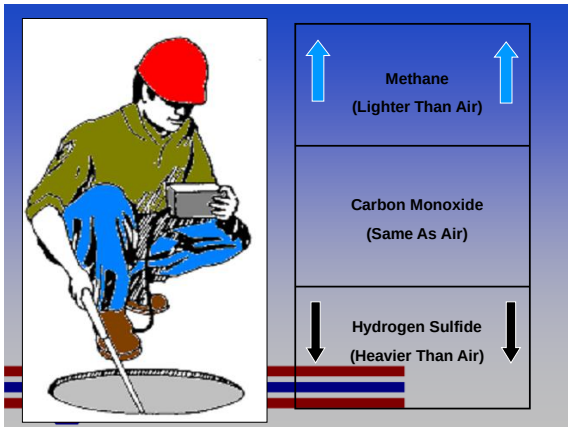

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General Limits

- Oxygen
  - MIN 19.5% - MAX 23.5%
- Flammability
  - 10% OF THE LEL
- Toxins
  - CO - 35 PPM
  - H_2S - 10 PPM.

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1 PPM is .....

- 1 ounce of sand in 31.25 tons of cement
- 1 inch in 16 miles
- 1 gram needle in 1 ton haystack
- 1 minute in 1.9 years
- 1 ounce of dye in 7,530 gallon of water
- 1 square inch in 1.6 acres of land
- 1 pound in 500 tons
- 1 penny in $ 10,000
- 1 ounce of salt in 62,000 lbs. of sugar
- 1/16 of an inch in a mile
- 1 drop in 521 gallons
- 1 word in a 2000 page novel
- 1 day in 2739 years.

22

Hydrogen Sulfide (H_2S)

- Smell Of Rotten Eggs
- Is Detected At Low Levels
- Rapidly Desensitizes Olfactory Nerves & Leads To False Sense Of Security
- High Concentrations Of H_2S, You May Collapse With Little Or No Warning.

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Effects of Hydrogen Sulfide Exposure

PPM	Effects and Symptoms	Time
10	Permissible Exposure Limit	8 hrs.
50-100	Mild Eye & Resp. Irritation	1 hr.
200-300	Marked Eye & Resp. Irritation	1 hr.
500-700	Unconsciousness, Death	½ hr.
1000	Unconsciousness, Death	Minutes

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Carbon Monoxide

- Odorless
- Colorless
- Tasteless
- Can Collapse With Little Or No Warning.

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Carbon Monoxide

- Synonyms
  - Flue gas, Exhaust gas
- Health Hazards
  - Highly toxic, Maybe fatal if inhaled
- Flammable Limits
  - Lower 12%
  - Upper 75 %
- Vapor Density
  - .097.

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Effects of Carbon Monoxide Exposure

PPM	Effects and Symptoms	Time
50	Permissible Exposure Limit	8 hrs.
200	Slight Headache, Discomfort	3 hrs.
400	Slight Headache, Discomfort	2 hrs.
600	Slight Headache, Discomfort	1 ½ hrs.
1000-2000	Confusion, Headache, Nausea	1 hr.
1000-2000	Tendency To Stagger	1 hr.
1000-2000	Heart Palpitations	½ hr.
2000-2500	Unconsciousness	20 minutes
4000+	Fatal	Minutes

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Other Recognized Hazards

- Electrical
- Mechanical
- Elevation Differences
- Hazardous Materials
- Noise
- Temperature Extremes.

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Electrical Hazards

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Mechanical Hazards

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Elevation Differences

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Hazardous Materials

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Noise

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Temperature Extremes

34

AIR MONITORING & VENTILATION

35

Characteristics of Monitoring Instruments

- Portability
- Able To Provide Reliable, Useful Results
- Sensitive And Selective
- Intrinsically Safe.

36

Types of Monitoring Equipment

- Direct Reading Instruments
  - Diffusion head assembly type
  - Electro-chemical sensor type
- Colorimetric Detector Tubes.

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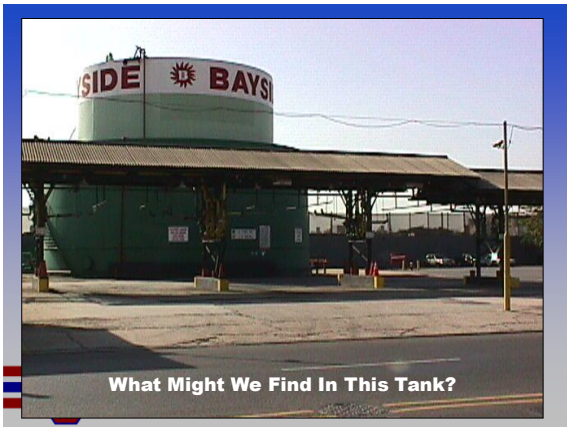

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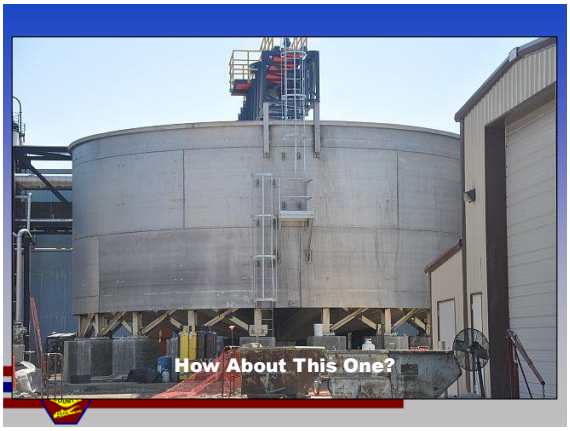

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Sequence of Testing

- FIRST – Oxygen Level
- SECOND – Flammability
- THIRD – Toxins.

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Levels of Testing

- General Area
- Top
- Middle
- Bottom
- Isolated Areas
  - Pipe or Tunnel.

41

NEVER TRUST YOUR SENSES TO DETERMINE IF THE AIR IN A CONFINED SPACE IS SAFE!

42

Ventilation Equipment

- Some Characteristics & Features:
  - Lightweight & portable
  - Provide minimum 600 cu. ft. / min
  - Have flexible hose connections
  - Intrinsically safe
- Should Have An Audible Alarm To Automatically Sound If There Is A Failure.

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Ventilation Equipment

- Smoke Ejector
- Commercial (Blowers)
- Fixed Site Systems.

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Types of Ventilation

- Positive Pressure
- Exhaust Site Pick-up
- Ventilation Issues
  - Short circuiting
  - Recirculating
  - Chimney Effect.

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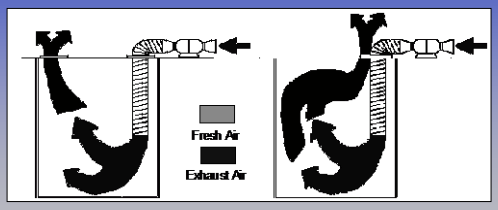
Positive Pressure (Supply) Ventilation



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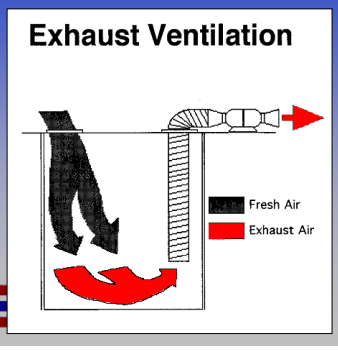
Exhaust Ventilation



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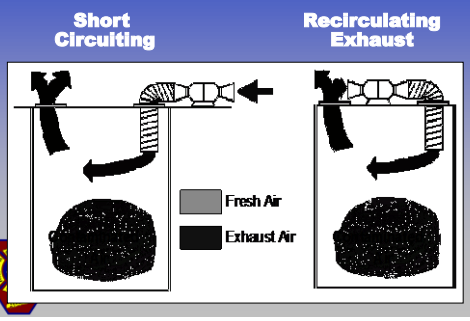
Ventilation Issues



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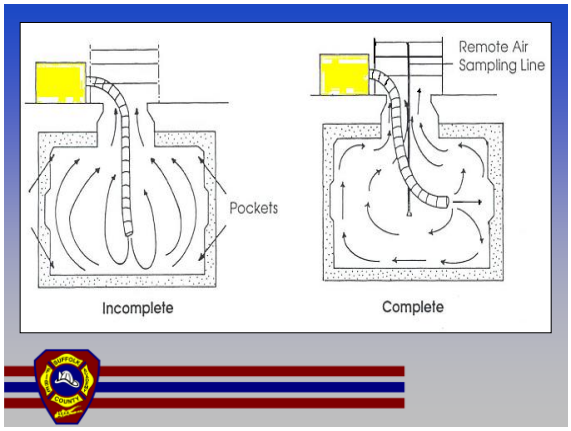

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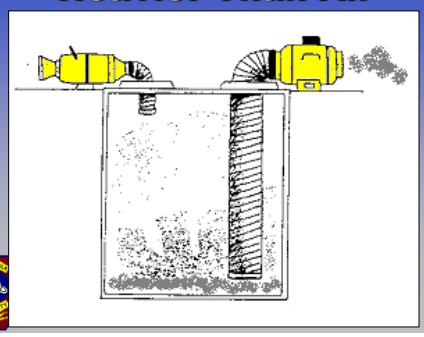
Atmosphere May Be Heavier Than Air



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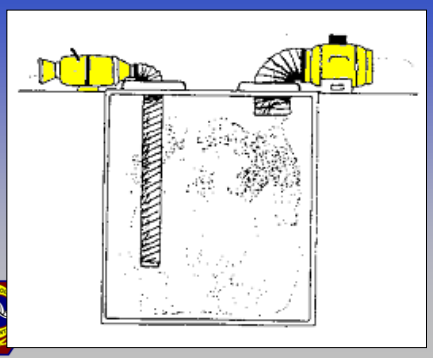
Lighter Than Air Product



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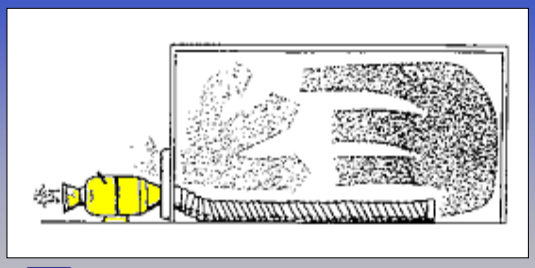
Venting A Long Space



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Blowing Air In And Exhausting

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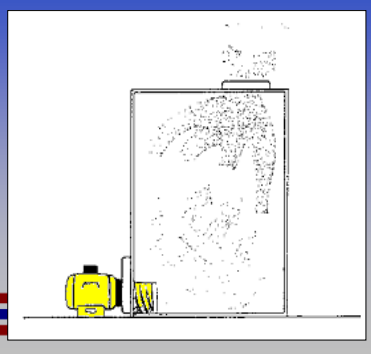
Venting Near Bottom



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A Space Under Positive Pressure Will Eventually Expel The Contaminants Through Any Openings In The Space.

Air Blows 30 Times Farther Than It Can Be Exhausted.

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Air Powered Fan

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HAZARD CONTROL

57

OSHA Isolation Procedure

1) Prepare For Shutdown
2) Shut Down The Equipment
3) Isolate The Equipment
4) Apply Lock-out, Tag-out and/or Bleed/Block Devices
5) Control Stored Energy
6) Verify Isolation Of The Space.

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Purpose of Regulation

To Prevent Accidents Due To Accidental / Equipment Start-up Or Unexpected Release Of Stored Energy During Maintenance Or Service.

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Stored Energy Includes

- Electrical Power
- Compressed Air
- Hydraulic Power
- Steam
- Movement Of Liquids Through Pipes.

60

Regulation Requirements

Lockout / Tagout Laws Require Employers Establish A Written Program

All Employees Must Be Trained & Know What Lockout / Tagout Signifies.

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Methods of Isolation

- Lock-Out, Tag-Out
- Bleed and Block
- Disconnect
- Blind and Blank
- FD Personnel / Guard.

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Space Isolation

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Lock-Out / Tag-Out Devices

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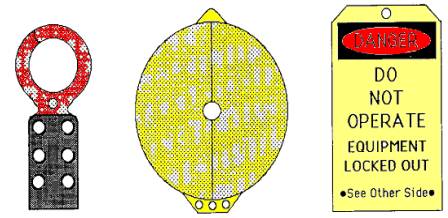
Lockout / Tagout Devices



Lockout Hasp | Valve Cover | Lockout Tag

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Lockout / Tagout Devices

- **Tags Should Be Standardized In Color, Shape, Size, Print And Format.**
- **OSHA Standards Require That The Tag Endure At Least 50 Lbs. Of Pull.**

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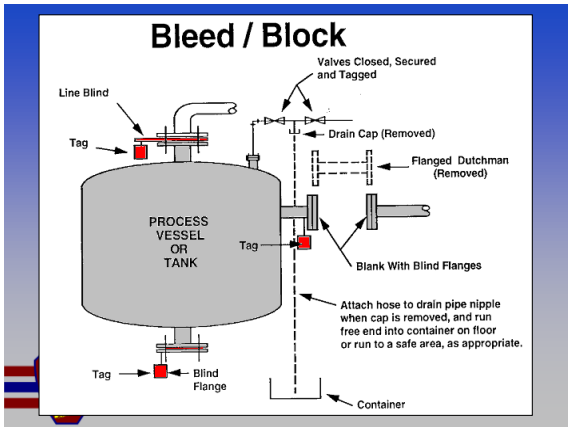

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Preparation For Shutdown

- Know The Types And Amount Of Energy That Powers The Equipment
- Know Their Hazards
- Know How The Energy Can Be Controlled

Equipment Shutdown

- Shut The Equipment Down By Using Operating Controls
- Follow Whatever Procedure Is Right For The Equipment.

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Application Of Lockout / Tagout Device

- Tag or Lock All Energy Devices
- Only Standardized Devices Supplied By Your Employer Should Be Used
- Use A Lockout Device If Your Lock Cannot Be Placed Directly On The Energy Control
- Every Employee Must Attach His Personal Tag
- More Than One Employee Can Lockout A Single Source With A Multiple Device
- For Big Jobs A Lockout Box Can Be Used
- Attach Tag To Same Spot As Locks Or As Close As Possible
- Fill Out Tag Completely And Correctly.

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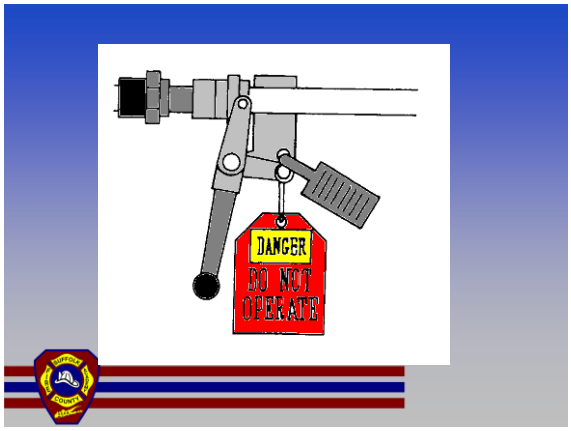

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Control of Stored Energy

- Inspect To Be Sure Parts Have Stopped Moving
- Install Ground Wires
- Release Trapped Pressure
- Release Trapped Tension
- Block Or Brace Parts That Could Fall
- Block Parts In Pneumatic And Hydraulic Systems That Could Move Due To Loss Of Pressure.

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Control of Stored Energy (Cont.)

- Bleed lines and leave vents open
- Close valves to prevent the flow of hazardous materials
- Use blank flanges in pipes where no valves are located to isolate product
- Dissipate extreme cold or heat unless wearing protective clothing (< 39, > 113)
- If stored energy can accumulate, monitor situation.

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Special Situations

- Outside Contractor And The On-site Employer Must Exchange Lockout / Tagout Information
- Alert To New Types Of Lockout / Tagout Devices
- If Servicing Lasts More Than 1 Work Shift, Lockout / Tagout Must Not Be *Interrupted*
- Employees Leaving Work Do Not Remove Their Locks Until The Ones Arriving Are Ready To Lockout
- The Lock Is Never Cut Unless A Supervisor Is Present And Worker Who Applied Lock Is Not There To Remove It.

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Removing Lockout / Tagout

- Remove All Tools From Area
- Be Sure System Is Fully Assembled
- Conduct Head Count
- Notify Everyone That Lockout / Tagout Removed
- Except In Emergency, Only Person To Remove Device Is Person Who Installed It
- Supervisor Always Removes His / Her Lock Last.

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Equipment Isolation

- Be Sure To Isolate All Energy Sources
- Never Pull Energy Switch While It Is Under Load
- Never Remove A Fuse Instead Of Disconnecting.

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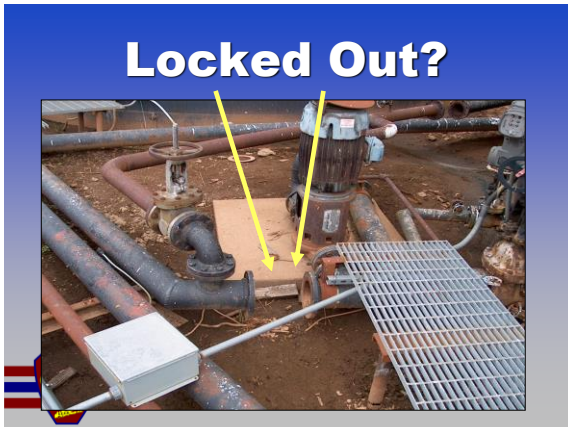

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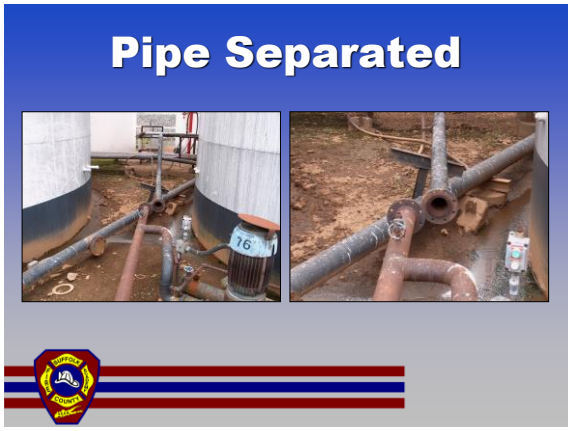

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COMMUNICATIONS

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Methods of Communications

- Electronic
- Manual
- Verbal.

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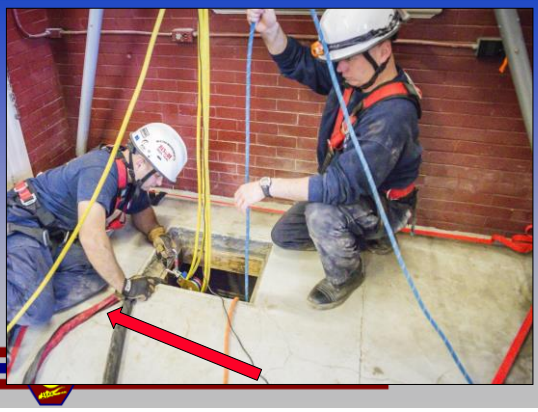

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Manual Tag Line Signals

- **O** – Ok – 1 Tug
- **A** – Advance – 2 Tugs
- **T** – Take-up – 3 Tugs
- **H** – Help – 4 Tugs.

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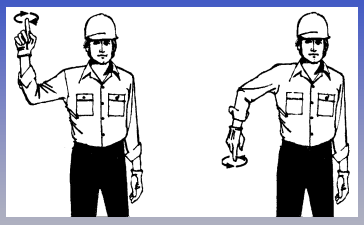
Hand Signals



Raise Lower

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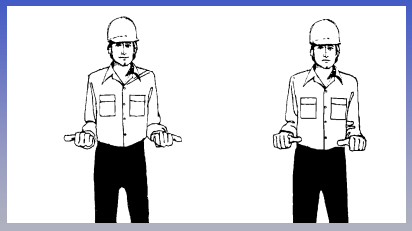
Hand Signals



Extend Retract

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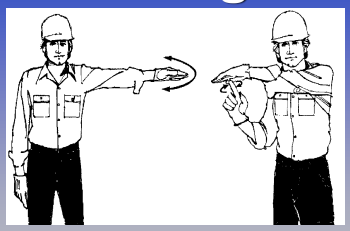
Hand Signals



Stop Move Slowly

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Verbal Communications

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PSYCHOLOGICAL EFFECTS OF CONFINED SPACES

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Anxiety

- Distress or An Uneasiness of The Mind
- A Reaction When You Feel Danger From:
  - A Person
  - An Object
  - A Situation
  - An Impulse.

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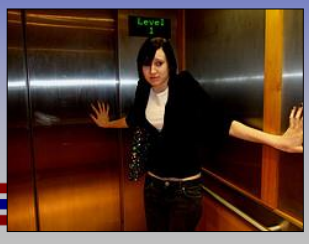
Phobias

- Persistent Fear of A Situation Or Object In Which The Level of Fear Is Not In Proportion To Its Actual Seriousness.



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Panic

- A Sudden Terror
- An Unreasoning, Infectious and Uncontrollable Fear.

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Causes of Fear In Confined Spaces

- Biological
  - Physical condition
  - Ingested chemicals
- Psychological
  - Subconscious forces
  - Personality disorders / pathological or abnormal behaviors.

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ASSESSMENT

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Assessment of Confined Space Incidents

- Recognize Situation For What It Actually Is
  - Initial dispatch may not convey the whole story (i.e. A/M Injuries From A Fall)
- Avoid Tunnel Vision
  - Beware of hidden hazards
- CALL FOR HELP IMMEDIATELY!!!!

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Assessment of Confined Space Incidents

- **STOP** and Evaluate
- Use Head, Not Heart
- Do Not Become A Victim.

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Actions To Take Prior To Rescue Team Arrival

- Secure Incident Scene
  - Would-be rescuers
  - General area hazard mitigation
- Gather Information
  - Entry permit
  - Site foreman
  - Bystanders
  - Attendant.

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Actions To Take Prior To Rescue Team Arrival

- Set-up Perimeter
- Monitor Atmosphere (Full PPE)
- Ventilation (Based on monitoring)
- Begin Required Pre-entry Procedures
- Determine Rescue vs. Recovery.

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CASE STUDIES

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Case Histories of Confined Space Incidents

Dated, but still applicable!

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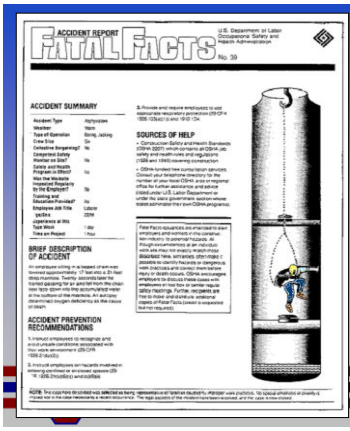

- Lowered Down On Looped Chain
- 17' Down Worker Fell
- O^2 Deficiency
- Died Of Asphyxiation

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Two Called Ill-Equipped for a Dangerous Job
WATER WELL RESCUE
Officials Say Well Cleaners Had Inadequate Safeguards

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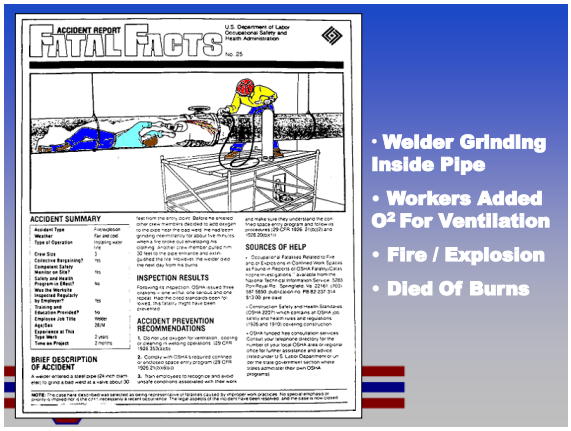
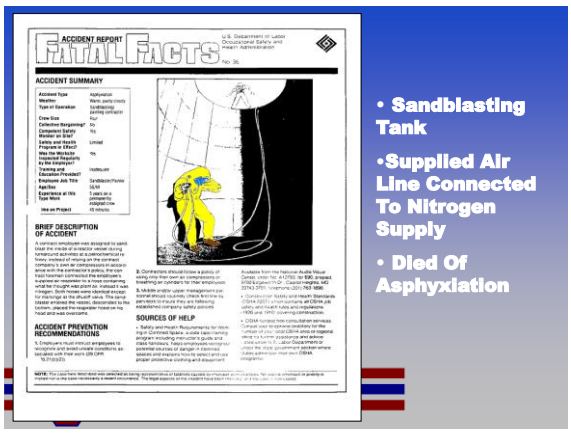

ACCIDENT REPORT
FATAL FACTS
U.S. Department of Labor
Occupational Safety and Health Administration
No. 25
ACCIDENT SUMMARY
BRIEF DESCRIPTION OF ACCIDENT
INSPECTION RESULTS
ACCIDENT PREVENTION RECOMMENDATIONS
SOURCES OF HELP
• Welder Grinding Inside Pipe
• Workers Added O2 For Ventilation
• Fire / Explosion
• Died Of Burns

101


ACCIDENT REPORT
FATAL FACTS
U.S. Department of Labor
Occupational Safety and Health Administration
No. 36
ACCIDENT SUMMARY
BRIEF DESCRIPTION OF ACCIDENT
ACCIDENT PREVENTION RECOMMENDATIONS
SOURCES OF HELP
• Sandblasting Tank
•Supplied Air Line Connected To Nitrogen Supply
• Died Of Asphyxiation

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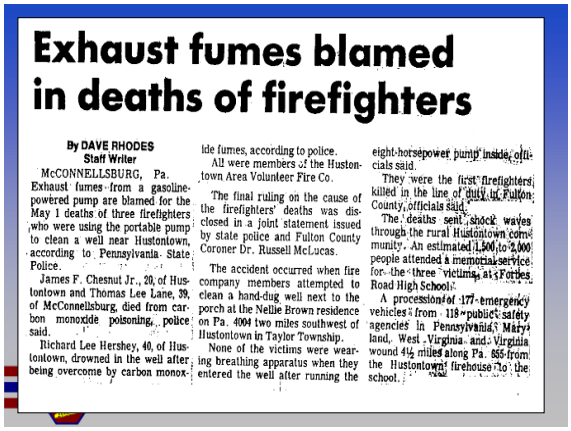

Exhaust fumes blamed in deaths of firefighters

By DAVE RHODES
Staff Writer

McCONNELLSBURG, Pa. Exhaust fumes from a gasoline-powered pump are blamed for the May 1 deaths of three firefighters who were using the portable pump to clean a well near Hustontown, according to Pennsylvania State Police.

James F. Chesnut Jr., 20, of Hustontown and Thomas Lee Lane, 39, of McConnellsburg, died from carbon monoxide poisoning, police said.

Richard Lee Hershey, 40, of Hustontown, drowned in the well after being overcome by carbon monoxide fumes, according to police.

All were members of the Hustontown Area Volunteer Fire Co.

The final ruling on the cause of the firefighters' deaths was disclosed in a joint statement issued by state police and Fulton County Coroner Dr. Russell McLucas.

The accident occurred when fire company members attempted to clean a hand-dug well next to the porch at the Nellie Brown residence on Pa. 4004 two miles southwest of Hustontown in Taylor Township.

None of the victims were wearing breathing apparatus when they entered the well after running the eight-horsepower pump inside, officials said.

They were the first firefighters killed in the line of duty in Fulton County, officials said.

The deaths sent shock waves through the rural Hustontown community. An estimated 1,500 to 2,000 people attended a memorial service for the three victims at Forbes Road High School.

A procession of 177 emergency vehicles from 118 public safety agencies in Pennsylvania, Maryland, West Virginia and Virginia wound 4½ miles along Pa. 655 from the Hustontown firehouse to the school.

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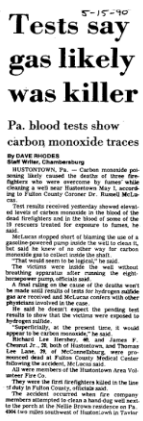
HAGERSTOWN, MD. Wednesday, May 2, 1990

Gas fumes kill three firefighters

18 others injured during well rescue



5-15-90

Tests say gas likely was killer

Pa. blood tests show carbon monoxide traces

By DAVE RHODES
Staff Writer, Chambersburg

HUSTONTOWN, Pa. — Carbon monoxide poisoning likely caused the deaths of three firefighters who were overcome by fumes while trying to clean a well near Hustontown, May 1, according to Fulton County Coroner Dr. Russell McLucas.

Test results received yesterday showed elevated levels of carbon monoxide in the blood of the dead firefighters and in the blood of some of the 18 rescuers treated for exposure to fumes, he said.

McLucas stopped short of blaming the use of a gasoline-powered pump inside the well, to clean it, but said he knew of no other way for carbon monoxide gas to collect inside the shaft.

"That would seem to be logical," he said.

The victims were inside the well without breathing apparatus after running the eight-horsepower pump inside, officials said.

A final ruling on the cause of the deaths won't be made until results of tests for hydrogen sulfide gas are received and McLucas confers with other physicians involved in the case.

He said he doesn't expect the pending test results to show that the victims were exposed to hydrogen sulfide.

"Unless somebody, at the present time, it would appear to be carbon monoxide," he said.

Richard Lee Hershey, 40, and James F. Chesnut Jr., 20, both of Hustontown, and Thomas Lee Lane, 39, of McConnellsburg, were pronounced dead at Fulton County Medical Center following the accident, McLucas said.

All were members of the Hustontown Area Volunteer Fire Co.

They were the first firefighters killed in the line of duty in Fulton County, officials said.

The accident occurred when fire company members attempted to clean a hand-dug well next to the porch at the Nellie Brown residence on Pa. 4004 two miles southwest of Hustontown in Taylor

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Newsday

MONDAY, JULY 25, 1994 • SUFFOLK 50

Together In Death

Close-Knit Father And 2 Sons Overcome While Fixing Underground Pump

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Long Island DAILY NEWS

Dad & sons may have suffocated

DIX HILLS CESSPOOL

The cesspool being repaired Sunday at the home of Gaspare Campo in Dix Hills was known as an overflow cesspool. It received waste water from the main cesspool about ten feet away.

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Do-It-Yourself Dangerous

By Phil Mintz
STAFF WRITER

Working on a septic system is not a job for amateurs, but an increasing number of people, many pinched by the recession and anxious to avoid the costs of repair work, are trying do-it-yourself fixes, cesspool cleaners said yesterday.

"A lot of homeowners are trying to fix problems themselves," said Ronald Monteleone, co-owner of Monty's Environmental Service of Dix Hills, which helped at the scene of an accident Sunday in which three people died in Dix Hills while working in an overflow pit to the family's cesspool. "In this incident, they figured it was okay to go down in a confined space and they found themselves in trouble."

It remained unclear yesterday what sort of sump pump problem Gaspare Campo and his sons, Anthony and Thomas, were trying to fix at their Dix Hills home on Sunday. Suffolk Homicide Squad Det. Sgt. Robert Doyle said yesterday that the Campos were not pumping tank liquid out of the ground.

Whatever work was being done, the cesspool cleaners all agreed that specialized equipment is needed to deal with the potentially noxious fumes within a septic system.

"You need monitors to test for oxygen levels, methane gas, you need breathing apparatus, and a hoist for the safety hook to be lowered down into the tank," said Keith Jeffrey, president of Martin Lang Cesspool in Bay Shore and president of the Long Island Liquid Waste Association, an industry group.

It's rare that cesspool cleaners have to enter a large commercial tank to clean it, and even rarer to have to go inside a residential cesspool, he said. In August, 1984, two cesspool company workers were killed and a third seriously injured when they were overcome by fumes while cleaning out a cesspool behind a restaurant in Roslyn Heights.

According to Monteleone and others, the cost of septic system repairs — which can range anywhere from $150 or so for a simple pumpout to several thousands of dollars for a replacement system — lead some do-it-yourself types to try to make their own repairs.

"Sometimes they use a sump pump [to clean out a cesspool] and run the water into a wooded area, which is illegal," said Steve Blasucci, president of Manhasset Scavenger Cesspools Inc., in Port Washington. Blasucci also said he's seen people let their cesspools overflow rather than pay for fixing it.

Others purchase over-the-counter chemicals, including sulfuric acid, to clear clogged cesspools, the cleaners said.

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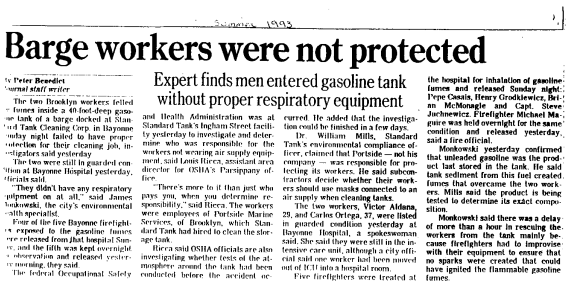

Summer 1993

Barge workers were not protected

Expert finds men entered gasoline tank without proper respiratory equipment

by Peter Beaudet
Journal staff writer

The two Brooklyn workers felled by fumes inside a 40-foot-deep gasoline tank of a barge docked at Standard Tank Cleaning Corp. in Bayonne Sunday night failed to have proper protection for their cleaning job, investigators said yesterday.

The two were still in guarded condition at Bayonne Hospital yesterday, officials said.

"They didn't have any respiratory equipment on at all," said James Monkowski, the city's environmental health specialist.

Four of the five Bayonne firefighters exposed to the gasoline fumes were released from that hospital Sunday, and the fifth was kept overnight for observation and released yesterday morning, they said.

The federal Occupational Safety and Health Administration was at Standard Tank's Ingham Street facility yesterday to investigate and determine who was responsible for the workers not wearing air supply equipment, said Louis Riera, assistant area director for OSHA's Parsippany office.

"There's more to it than just who pays you, when you determine responsibility," said Riera. The workers were employees of Portside Marine Services, of Brooklyn, which Standard Tank had hired to clean the storage tank.

Riera said OSHA officials are also investigating whether tests of the atmosphere around the tank had been conducted before the accident occurred. He added that the investigation could be finished in a few days.

Dr. William Mills, Standard Tank's environmental compliance officer, claimed that Portside — not his company — was responsible for protecting its workers. He said subcontractors decide whether their workers should use masks connected to an air supply when cleaning tanks.

The two workers, Victor Aldana, 29, and Carlos Ortega, 37, were listed in guarded condition yesterday at Bayonne Hospital, a spokeswoman said. She said they were still in the intensive care unit, although a city official said one worker had been moved out of ICU into a hospital room.

Five firefighters were treated at the hospital for inhalation of gasoline fumes and released Sunday night: Pepe Casais, Henry Grodkiewicz, Brian McMonagle and Capt. Steve Juchnewicz. Firefighter Michael Maguire was held overnight for the same condition and released yesterday, said a fire official.

Monkowski yesterday confirmed that unleaded gasoline was the product last stored in the tank. He said tank sediment from this fuel created fumes that overcame the two workers. Mills said the product is being tested to determine its exact composition.

Monkowski said there was a delay of more than a hour in rescuing the workers from the tank mainly because firefighters had to improvise with their equipment to ensure that no sparks were created that could have ignited the flammable gasoline fumes.

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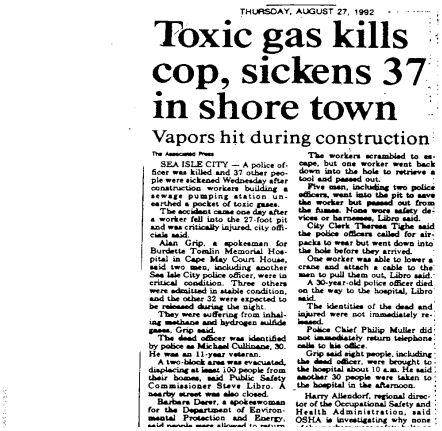

THURSDAY, AUGUST 27, 1992

Toxic gas kills cop, sickens 37 in shore town

Vapors hit during construction

The Associated Press

SEA ISLE CITY — A police officer was killed and 37 other people were sickened Wednesday after construction workers building a sewage pumping station unearthed a pocket of toxic gases.

The accident came one day after a worker fell into the 27-foot pit and was critically injured, city officials said.

Alan Grip, a spokesman for Burdette Tomlin Memorial Hospital in Cape May Court House, said two men, including another Sea Isle City police officer, were in critical condition. Three others were admitted in stable condition, and the other 32 were expected to be released during the night.

They were suffering from inhaling methane and hydrogen sulfide gases, Grip said.

The dead officer was identified by police as Michael Cullinane, 30. He was an 11-year veteran.

A two-block area was evacuated, displacing at least 100 people from their homes, said Public Safety Commissioner Steve Libro. A nearby street was also closed.

Barbara Dawe, a spokeswoman for the Department of Environmental Protection and Energy, said crews were allowed to return

The workers scrambled to escape, but one worker went back down into the hole to retrieve a tool and passed out.

Five men, including two police officers, went into the pit to save the worker but passed out from the fumes. None wore safety devices or harnesses, Libro said.

City Clerk Theresa Tighe said the police officers called for air packs to wear but went down into the hole before they arrived.

One worker was able to lower a crane and attach a cable to the men to pull them out, Libro said.

A 30-year-old police officer died on the way to the hospital, Libro said.

The identities of the dead and injured were not immediately released.

Police Chief Philip Muller did not immediately return telephone calls to his office.

Grip said eight people, including the dead officer, were brought to the hospital about 10 a.m. He said another 30 people were taken to the hospital in the afternoon.

Harry Allendorf, regional director of the Occupational Safety and Health Administration, said OSHA is investigating why none

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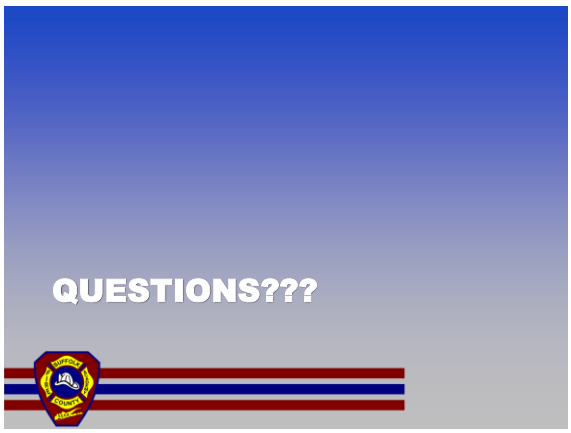

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