Rescuers Account for Over 60% of Confined Space Fatalities
Confined Space Tragedies

Three construction supervisors die from asphyxiation in a manhole. Oxygen levels 18.5 – 20 and Methane levels 300 – 600 ppm
Training Outline

- What is a Confined Space?
- Confined Spaces on Campus
- Confined Space Hazards
- PPE & Equipment Requirements
- The Entry Permit
- Duties of Authorized Entrants, Attendants and Entry Supervisor
- Rescue and Emergency Services
- Contractors
Regulatory Requirement

OSHA 29 CFR 1910.146: Permit-Required Confined Spaces - (Jan 1993)

- Identify Confined Spaces in Workplace
- Identify hazards in these spaces
- Identify procedures for controlling these hazards
- Train employees on confined space entry
- Keep records of compliance & training for all confined space activities
What is a Confined Space?

- Large enough that an employee can enter and perform assigned work
- Has limited or restricted means for entry or exit
- Not designed for continuous employee occupancy
Examples

tanks
pits
tunnels
vaults
boilers
sewers
shafts
ventilation ducts
crawl spaces
Permit-Required Confined Space

Contains or has the potential to contain a hazardous atmosphere
Contains a material that has the potential for engulfing an entrant
Internal configuration that might cause entrant to be trapped or asphyxiated by inwardly converging walls or floor that slopes downward and tapers to a smaller cross section
Contains any other recognized serious safety or health hazard
## ECU Confined Spaces

### Main Campus

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Location</th>
<th>Permit Required Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boilers # 1-4</td>
<td>Boiler</td>
<td>14th St. Steam Plant</td>
<td>Yes</td>
</tr>
<tr>
<td>DA Tank</td>
<td>Tank</td>
<td>14th St. Steam Plant</td>
<td>Yes</td>
</tr>
<tr>
<td>Condensate Tank</td>
<td>Tank</td>
<td>14th St. Steam Plant</td>
<td>Yes</td>
</tr>
<tr>
<td>Steam Tunnel</td>
<td>Manhole</td>
<td>Main Campus</td>
<td>Yes</td>
</tr>
<tr>
<td>All Steam Manholes</td>
<td>Manhole</td>
<td>Main Campus</td>
<td>Yes</td>
</tr>
<tr>
<td>All Electrical Manholes</td>
<td>Manhole</td>
<td>Main Campus</td>
<td>Yes</td>
</tr>
<tr>
<td>All Sanitary Sewer Manholes</td>
<td>Manhole</td>
<td>Main Campus</td>
<td>Yes</td>
</tr>
<tr>
<td>All Storm Sewer Manholes</td>
<td>Manhole</td>
<td>Main Campus</td>
<td>Yes</td>
</tr>
<tr>
<td>Crawl Spaces</td>
<td>Crawl Space</td>
<td>Main Campus</td>
<td>No</td>
</tr>
<tr>
<td>Surge Tank</td>
<td>Vault</td>
<td>Student Rec Center</td>
<td>No</td>
</tr>
<tr>
<td>Steam Cloud</td>
<td>Vault</td>
<td>Joyner Library Plaza</td>
<td>No</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td>Location</td>
<td>Permit Required Space</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------</td>
<td>------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>All Manholes</td>
<td>Manhole</td>
<td>HSC</td>
<td>Yes</td>
</tr>
<tr>
<td>All Storm Drain Lines</td>
<td>Open Lines</td>
<td>HSC</td>
<td>No</td>
</tr>
<tr>
<td>Backflow Vault - LSA #2</td>
<td>Vault</td>
<td>HSC</td>
<td>No</td>
</tr>
<tr>
<td>Backflow Vault - behind Steam Plant</td>
<td>Vault</td>
<td>HSC</td>
<td>No</td>
</tr>
<tr>
<td>Boilers (#1, 2, &amp; 3)</td>
<td>Boiler</td>
<td>Utility Plant</td>
<td>Yes</td>
</tr>
<tr>
<td>Incinerator (Upper &amp; Lower Chambers)</td>
<td>Chamber</td>
<td>Utility Plant</td>
<td>Yes</td>
</tr>
<tr>
<td>DA Tank</td>
<td>Tank</td>
<td>Utility Plant</td>
<td>Yes</td>
</tr>
<tr>
<td>Pipe Chase by HVAC Office</td>
<td>VS</td>
<td>Utility Plant</td>
<td>Yes</td>
</tr>
<tr>
<td>High Voltage Under Main Switch Gear</td>
<td>VT</td>
<td>Utility Plant</td>
<td>Yes</td>
</tr>
<tr>
<td>Fume Exhaust Plenum Roof</td>
<td>VB</td>
<td>Brody</td>
<td>Yes</td>
</tr>
<tr>
<td>8th Floor Mech. Rm P3 Exhaust Plenum</td>
<td>VS</td>
<td>Brody</td>
<td>Yes</td>
</tr>
<tr>
<td>Mech Rm 003 1st Floor</td>
<td>Pit</td>
<td>Biotech</td>
<td>No</td>
</tr>
<tr>
<td>Mech Rm 155 Tank</td>
<td>Tank</td>
<td>Warren Life Sciences</td>
<td>Yes</td>
</tr>
<tr>
<td>Mech Rm 155 Pit</td>
<td>Pit</td>
<td>Warren Life Sciences</td>
<td>No</td>
</tr>
<tr>
<td>Courtyard Steam Pit</td>
<td>Pit</td>
<td>Leo Jenkins</td>
<td>Yes</td>
</tr>
<tr>
<td>All Manholes and Pits</td>
<td>Manhole</td>
<td>West Research</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Atmospheric Hazards

**Oxygen Levels** - below 19.5% or above 23.5%

**Flammable/Explosive** – exceeds 10% of Lower Explosive Limit (LEL)

**Toxic Substances** – exceed Permissible Exposure Limits (PEL)
Oxygen Deficiency

Normal air contains 21% Oxygen ($O_2$). An $O_2$ level of 19.5% or less is considered $O_2$ deficient.

A reduction in $O_2$ can be caused by rusting, decomposition, or replacement by another gas.

Lack of $O_2$ can cause a person to collapse and die.
# Oxygen Deficiency

<table>
<thead>
<tr>
<th>Oxygen Content (% by volume)</th>
<th>Signs and Symptoms (at Atmospheric Pressure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.5%</td>
<td>Minimum permissible levels that work can be performed without respirators. Below this level, workers shall be required to wear supplied air respirators.</td>
</tr>
<tr>
<td>17%</td>
<td>Hypoxia symptoms, accelerated breathing and heart rate appear</td>
</tr>
<tr>
<td>14-16%</td>
<td>Accelerated breathing, increased heart rate, poor muscular coordination, fatigue, impaired perception and judgment.</td>
</tr>
<tr>
<td>12%</td>
<td>Unconsciousness without warning, poor judgment, blue lips</td>
</tr>
<tr>
<td>6-10%</td>
<td>Nausea, vomiting, and unconsciousness; 8 minutes 100% fatal; 6 minutes, 50% fatal; 4-5 minutes, recovery with treatment.</td>
</tr>
<tr>
<td>&lt;6%</td>
<td>Coma in 40 seconds, spasmatic breathing, convulsions, and death</td>
</tr>
</tbody>
</table>
Oxygen Enrichment

$O_2$ levels above 23.5% are considered “Oxygen Enriched.”

Oxygen Enriched atmospheres create fire and explosion hazards.

Cause flammable materials such as clothing to burn rapidly when ignited and may cause non-flammable materials to ignite.
# Hydrogen Sulfide Exposure

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ppm</td>
<td>Smell of rotten egg</td>
</tr>
<tr>
<td>10 ppm</td>
<td>8 hr. TWA</td>
</tr>
<tr>
<td>15 ppm</td>
<td>15 min. STEL</td>
</tr>
<tr>
<td>100 ppm</td>
<td>Lose sense of smell</td>
</tr>
<tr>
<td>300 ppm</td>
<td>Loss of consciousness (approx. 20 min.)</td>
</tr>
<tr>
<td>1000 ppm</td>
<td>Immediate respiratory arrest, loss of consciousness, followed by death</td>
</tr>
</tbody>
</table>
## Carbon Monoxide Exposure

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 ppm</td>
<td>8 hr. TWA</td>
</tr>
<tr>
<td>200 ppm</td>
<td>Ceiling, faint signs of discomfort may begin to appear</td>
</tr>
<tr>
<td>600 ppm</td>
<td>Headache and discomfort after 1 hour</td>
</tr>
<tr>
<td>2500 ppm</td>
<td>Loss of consciousness after approximately 30 minutes</td>
</tr>
<tr>
<td>4000 ppm</td>
<td>Quickly fatal</td>
</tr>
</tbody>
</table>

**CO Poisoning can be reversed if caught in time.**
Welding in Confined Spaces

- Continuous ventilation should be provided in the confined space. Pure oxygen should never be used for ventilation.

  Conduct continuous monitoring throughout the entry to ensure that the area remains safe for entrants.

  Gas cylinders and welding power sources should remain outside the confined space.

Remember to follow all Confined Space Entry and Welding Safety Guidelines
Physical Hazards

- Engulfment
- Temperature Extremes
- Electrical Hazards
- Noise
- Slippery Surfaces
"Entry" is when a person passes through an opening into a permit-required confined space. Any part of the entrant's body breaks the plane of an opening into the space.
**Before Entry**

Ventilate, eliminate, or control the space’s atmospheric hazards

Blind or disconnect and cap all input lines so that no hazardous materials can enter the space

Lockout/Tagout

When entrance covers are removed, guard the opening immediately
Atmospheric Monitoring

- Test permit space before entry
- Periodically monitor permit space to determine if entry conditions are maintained
- Test all areas (top, middle, & bottom)
- Observe status of existing hazards and those created during entry operations
Personal Protective Equipment (PPE)

- Full-body Harness
- Respirator (half-mask, PAPR, Air-line Respirator, etc.)
- Tyvek Suit
- Gloves (Nitrile, Welding, etc.)
- Safety Glasses/Goggles
Equipment Requirements

- Testing and monitoring equipment
- Ventilating equipment
- Communications equipment
- Lighting equipment
- Barriers
- Equipment needed for safe entry and exit
- Emergency equipment
- Other equipment for safe entry
The Entry Permit

Permit must be completed before entry is authorized.
Entry supervisor must sign the permit.
Permit must be made available at the time of entry so entrants can confirm that pre-entry preparations have been completed.
The Entry Permit

Duration may not exceed the time identified on the permit
Retain each canceled entry permit for at least 1 year to facilitate review of the program
Problems encountered during entry shall be noted on the permit so that appropriate revisions can be made to the program
# East Carolina University Confined Space Entry Permit

## 1. General Information
- **Permit Number:** 2018-19
- **Department Conducting Entry:** Facilities Services - Steam Shop
- **Location/Identity of Space to be Entered:** Unity Tunnel - Graham Manhole
- **Purpose of Entry:**
  - [X] Inspection
  - [ ] Maintenance
  - [ ] Repair
  - [ ] Hot work
  - [ ] Other
- **Authorized Duration of Entry:**
  - **Date:** 5/19/08 to 5/19/08
  - **Time:** 10:30 am to 5:00 pm

## 2. Authorized Entrants and Attendants
- **Entrants:**
  - Contractor: David Holladay
- **Attendants:**
  - Robert Still

## 3. Hazard Evaluation

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒</td>
<td></td>
</tr>
</tbody>
</table>

- Can the work be performed outside the space through use of special tools or other methods?
- Does the space contain an oxygen deficient atmosphere [less than 19.5% O2]?
- Does the space contain an oxygen rich atmosphere [greater than 23.5% O2]?
- Does the space contain flammable gases or vapors [greater than 1.0% of LEL]?
- Does the space contain combustible dusts or ignitable residues, fuels or exceed LEL?
- Does the space have toxic gases or vapors [greater than PEL]?
- Does the space contain material that may engulf entrants?
- Does the space contain other hazards/potential hazards [gas lines or sewer lines, electrical hazards, temperature extremes, trip hazards, standing water, asbestos, etc.]. Specify - Heat, water, asbestos.

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒</td>
<td></td>
</tr>
</tbody>
</table>

- Will work performed in the space create a hazard [welding, chemical use, etc.]. Specify -

## 4. Contractors' Safety

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒</td>
<td></td>
</tr>
</tbody>
</table>

- Will contractors participate in this entry? If no, proceed directly to SECTION 5.
- Has the entry been coordinated with the contractor and has the contractor been informed of the hazards identified in the space and measures taken to protect employees from these hazards?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒</td>
<td></td>
</tr>
</tbody>
</table>

- Has the contractor informed the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces?

## 5. Equipment Required for Entry
- **Personal Protective Equipment:** Full Body Harness.
- **Respiratory Protection:** Half-mask w/HEPA filter
- **Atmospheric Testing/Monitoring Equipment:**
  - [X] PhD lus
  - [ ] MultiGas lus
  - [ ] Calibration Data
- **Communication Equipment:**
  - [ ] Visual, Radio
- **Rescue Equipment:**
  - [ ] Tripod with Manline
  - [ ] Other:

## 6. Emergency Services
<table>
<thead>
<tr>
<th>Name of Service</th>
<th>Phone Number</th>
<th>Method of Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenville Fire and Rescue</td>
<td>911</td>
<td>Radio communication via ECU Police and/or Telephone</td>
</tr>
</tbody>
</table>
Contents of The Entry Permit

1. Permit space to be entered
2. Purpose of the entry
3. Date and the authorized duration of the entry permit
4. Authorized entrants
5. Attendants
6. Entry supervisor with a space for the signature
Contents of The Entry Permit

7. Hazards of the permit space
8. Measures used to isolate the permit space and to eliminate or control permit space hazards before entry
9. Acceptable entry conditions
10. Results of initial and periodic tests, names or initials of the testers and when the tests were performed
11. Rescue and emergency services
12. Communication procedures
13. Equipment (personal protective equipment, testing equipment, communications equipment, alarm systems, rescue equipment, etc.)
14. Any other information necessary in order to ensure employee safety
Duties of Authorized Entrants

- Understand all potential hazards
- Know what equipment to use & how to use it properly
- Communicate with attendant regularly
- If the unexpected occurs – alert the attendant
Duties of Authorized Entrants

EVACUATE the confined space when:

Order to evacuate is given by the attendant or the entry supervisor

Entrant recognizes any warning sign or symptom of exposure to a dangerous situation

Evacuation alarm is activated
Duties of Attendants

"Attendant" - stationed outside permit space; monitors entrants
Know the hazards including signs, symptoms and consequences of exposure
Continuously maintains accurate count of entrants in permit space
Remains outside the permit space during entry until relieved by another attendant
Duties of Attendants

- Communicate with entrants to monitor entrant status and to alert entrants if the need to evacuate arises.
- Monitor activities inside & outside the space and keep unauthorized individuals away.
- Summon Emergency Services.
- Perform non-entry rescues when applicable and they have training.
- Perform no duties that might interfere with primary duty to monitor and protect entrants.
"Entry supervisor" - person responsible for determining if acceptable entry conditions are present, for authorizing entry, overseeing entry operations, and for terminating entry as required.

An entry supervisor also may serve as an attendant or as an entrant, as long as that person is trained and equipped to do so.

Know the hazards including signs, symptoms, and consequences of exposure.
Duties of Entry Supervisor

Verify that the entry permit is complete, all tests have been conducted and all procedures and equipment are in place before allowing entry to begin.

Verify that rescue services are available and that the means for summoning them are operable.

Remove unauthorized individuals who enter or attempt to enter the space.
Rescue and Emergency Services

Self-Rescue
Non-entry Rescue
Greenville Fire/Rescue – Call 911
ECU shall inform GFR of the hazards they may encounter on site
Provide the rescue provider with access to all permit spaces so they can develop rescue plans and practice rescue operations
Rescue Equipment

Each entrant shall use a full body harness (and a retrieval line if feasible)

A mechanical retrieval device (Tripod) shall be available for vertical type permit spaces more than 5 feet deep

Retrieval systems shall be used unless they increase the overall risk of entry or would not contribute to the rescue
Program Review

Review entry operations when there is reason to believe that measures taken may not protect employees and revise the program before subsequent entries.

Review the permit space program annually and revise the program as necessary to ensure that employees participating in entry operations are protected.

If you have any questions, concerns, or recommendations let your supervisor and/or EH&S know.
Inform contractor that workplace contains permit spaces and entry is allowed only in compliance with permit space program
Inform contractor of the hazards that make the space a permit space
Inform contractor of precautions for the protection of employees in or near permit spaces where they will be working
Coordinate entry operations with the contractor, when both University personnel and contractor personnel will be working in or near permit spaces.
Contractors Shall...

All contractors performing work in Confined Spaces on ECU Campus must have a Confined Space Program.

Contractors must have their own equipment including monitoring device and rescue equipment.

Coordinate with employer when both host personnel and contractor personnel will be working in or near spaces.

Debrief employer at the conclusion of entry.

Contractor shall inform the employer of the of any hazards confronted or created.
QUESTIONS?
safety@ecu.edu
328-6166
Click the link to complete the Quiz