



# **205 ENVIRONMENTAL HEALTH & SAFETY PROGRAMS**

**By: Allen Boyette, PE, CEFP  
Senior Director, Energy Systems  
NC State University**

Credit(s) earned on completion of this course will be reported to American Institute of Architects (AIA) Continuing Education Session (CES) for AIA members.

Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

**AIA**  
**Continuing**  
**Education**  
**Provider**

## Course Description

This course will provide a basic overview of plant safety (OSHA, confined space, workers comp, MSDS, shop safety rules) and campus safety including lighting, fire and life safety, and general security. The presentation will also provide an introduction to regulatory compliance issues related to hazardous materials, indoor air quality, clean air, and clean water.

# Learning Objectives

- Learn the responsibilities for development, oversight, and management of environmental, health and safety programs.
- Learn to develop programs to protect the environment, provide safe and healthy conditions for work and study and comply with applicable laws and regulations.
- Learn regulatory compliance issues regarding hazardous materials, indoor air quality, clean air and water.
- Review OSHA requirements.

# How does Facilities Department view Environmental, Health and Safety Department?



**I am just trying to do my job!!!**

## AGENDA

- Worker Safety
- Campus Safety
- Environmental Affairs

## GOALS

- Provide overview of programs
- Awareness of wide range of areas affecting Facilities Professionals
- Better able to partner: Facilities and EH&S



# WORKER SAFETY – WHY WORRY ABOUT IT???

- From 2011 to 2018 – Increase of 12% workers killed on the job
- 5190 workers died on the job in 2021
- Approximately 100 per week and about 14 every day

Good News – workplace fatalities reduced 60% and occupational injury and illness rates reduced 70% since 1970



**“Why didn’t I walk on the inside?”**





# WORKER SAFETY – WHY WORRY ABOUT IT???

Making a living shouldn't have to cost you your life. Workplace fatalities, injuries, and illnesses are preventable. Safe jobs happen because ***employers*** make the choice to fulfill their responsibilities and protect their workers.

— Dr. David Michaels *Assistant Secretary of Labor for Occupational Safety and Health*

## Employee Safety

- It is the right thing to do!
- Encourage Team Work, enjoy a safe work place



# WORKER SAFETY – WHY WORRY ABOUT IT???

Has your organization had an accident and do you have someone currently on workers compensation???

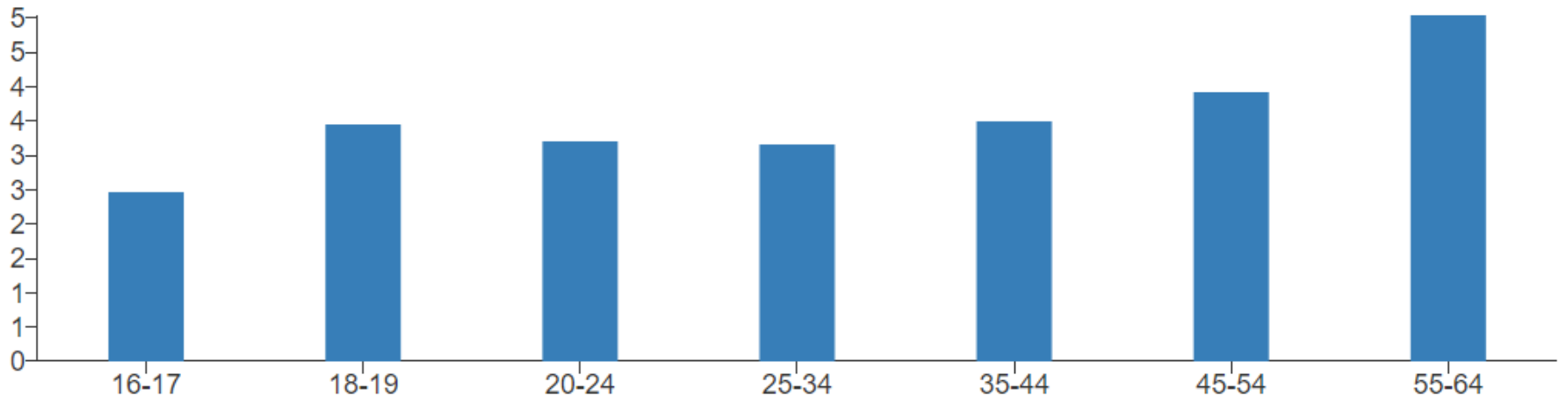
# CLASSWORK FIRST

- TOP THREE SAFETY or HEALTH ISSUES
  - Items you are concerned about
  - Items you spend the most time on
- INCLUDE YOUR AREA OF WORK
  - Utilities, Building Maintenance, Housekeeping, Grounds, Design/Construction, Administration

## PREVIOUS CLASS RESPONSES

- Slips, Trips, & Falls
- Low speed vehicles
- Electrical/ArcFlash
- Asbestos
- Lab Safety
- Pedestrian/Bike/Vehicle interactions
- Air Quality/Mold
- Aging Work force

# Fatality Rates/100,000 Fulltime Equivalents (FTE) by Age Group



Thirty-five percent of all fatalities occurred in workers age 55 or older, and workers 65 or older have three times the risk of dying on the job as other workers.

# What Is An Accident?

An unplanned, unwanted, but controllable event which disrupts the work process and causes injury to people.



Most everyone would agree that an accident is unplanned and unwanted. The idea that an accident is controllable might be a new concept. An accident stops the normal course of events and causes property damage or personal injury, minor or serious, and occasionally results in a fatality.

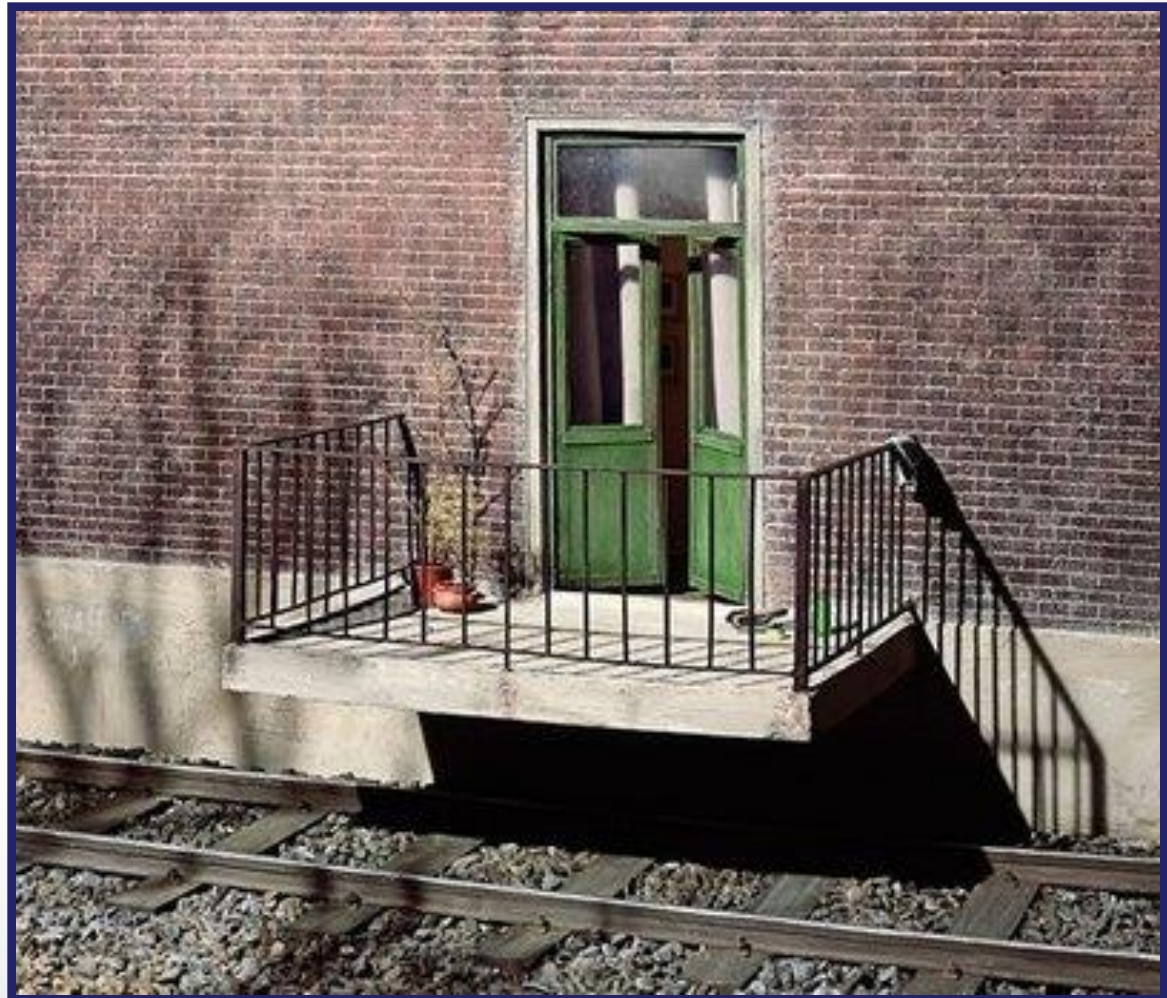


## REGULATORY OVERVIEW

- Federal Department of Labor
- Occupational Safety & Health (OSH) Act of 1970
- Created Federal Agency OSHA – Occupational Safety & Health Administration
  - Sets and enforces protective workplace safety & health standards
- OSHA partners with State OSH agencies to carry out the program



- Don't just go through the motions
- Don't just meet the letter of the law, but meet the intent



## SAFETY CULTURE

- Is safety part of your work culture?
- If the answer is yes, then these pictures look normal.



## SAFETY CULTURE

- So, if everybody agrees what “right looks like” why do we have unplanned and preventable workplace injuries?
- Because,
  - We develop bad habits.
  - We take unnecessary risks.

## CREATE NEW HABITS

- How many people would put their baby or grandbaby in a car without a car seat?

Our dangerous habits changed to a positive habit through awareness.

## Why do we develop bad habits and take unnecessary risks?

- Just get it done!
- Just this once.
- I did it this way last time and did not get hurt.
- Precautions take too much time.
- I can do it.
  - With no training nor the proper tool
- Just don't think?



# Why do we develop bad habits and take unnecessary risks?



# Why do we develop bad habits and take unnecessary risks?





# Why do we develop bad habits and take unnecessary risks?



## Three inter-related keys to creating a culture of safety awareness

- Training – Knowledge and Awareness
  - Participation – At all Levels
  - Communication – Demonstrate genuine concern
- 
- Risk Assessment – Risk Mitigation

## Common Sense

- Risk Assessment = Slow down and think about what can go wrong
  - You are more of an expert than you think if you pay attention
- Risk Mitigation = Take action to reduce the risk
  - Is there another way to do this task?
  - What is the proper Personal Protective Equipment for the task (PPE)?

# So why would you?



**Safety is everyone's job!**





Would you walk past this without saying something?



**Would you walk past this without saying something?**



# TOPICS FACILITIES PROFESSIONALS DEAL WITH

- Fall Protection
  - Hearing Conservation
  - Confined Space
  - Energy Sources and safe O&M
  - Cleaning procedures
  - Asbestos
- 
- New 29CFR1910 Communication Standard
  - Processes, Procedures, and PPE



# Hazard ID and Mitigation

Before each job task, consider safety. Learn more and submit your ideas for improving Facilities Division safety at [facilities.ofa.ncsu.edu/safety](https://facilities.ofa.ncsu.edu/safety)

## STEP 1

### Identify Hazards



Mechanical



Electrical



Pressure



Vehicle



Health



Ergonomics



Struck By  
or Against



Temperature



Slip | Trip  
Fall



Chemical

## STEP 2

### Assess Hazards

How could the hazards affect safe completion of the job?

## STEP 3

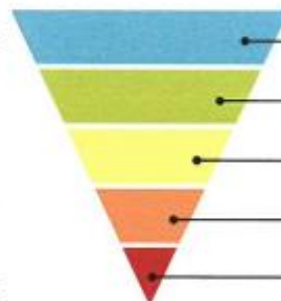
### Establish Controls

Use the hierarchy of controls.

MOST  
EFFECTIVE



LEAST  
EFFECTIVE



## STEP 4

### Monitor Effectiveness

Verify controls are effective for the entire duration of the job.

#### Elimination

Physically remove the hazard

#### Substitution

Replace the hazard

#### Engineering

Isolate people from the hazard

#### Procedure

Change the way people work

#### Personal Protective Equipment

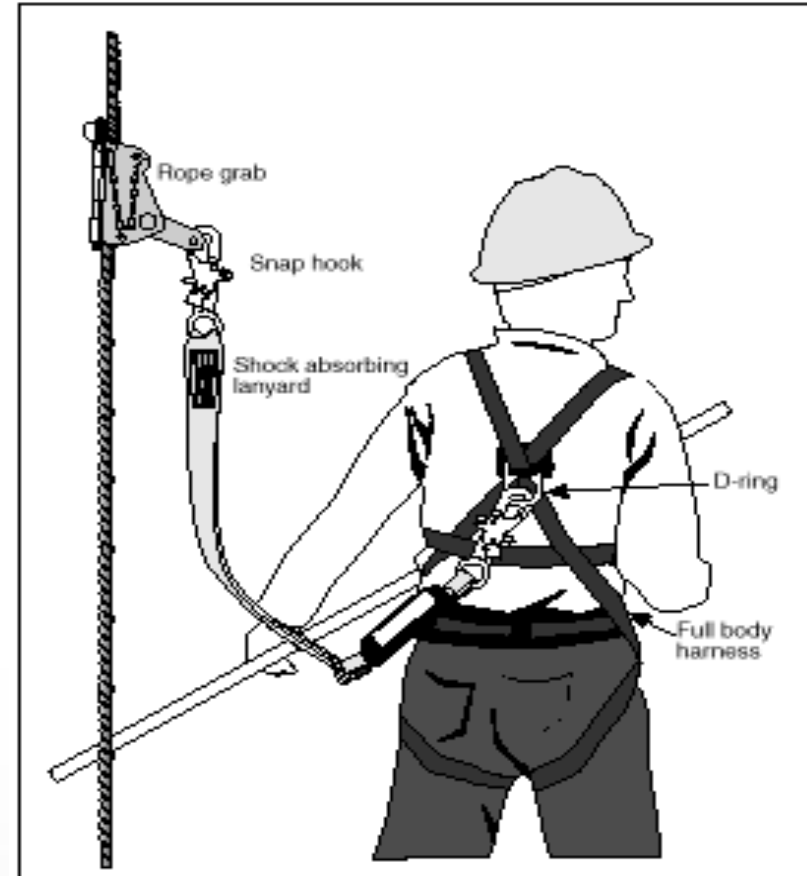
Protect the worker with PPE

*If you are unsure how to control a hazard, PAUSE and talk to your supervisor.*

# Fall Protection

- ✓ 29 CFR 1926 SUBPART M
- ✓ Employers must determine if the walking/working surfaces have the **strength** and **structural integrity** to support employees safely
- ✓ Employees must determine if their walking working surface will support them safely
- ✓ Fall Protection at or greater than 6 feet

# Passive vs Active Fall Protection



# Hearing Conservation Program

- Employer must have a Hearing Conservation Program

# Hearing conservation Program

Training on risk and proper hearing protection

When first hired, a baseline test – audiometric test

The testing is repeated every year after that and compared to the baseline test result.

If a hearing loss is detected, refer to a doctor or audiologist.



# What is Too Much Noise Exposure?

The risk of hearing loss increases dramatically as noise levels increase.

Exposure to noise levels above 115 decibels for even five minutes is very risky.

Impact or banging noise above 140 decibels will cause immediate damage to nerves in the ear.



## Confined Space

- Open top enclosures with depths that restrict natural movement of air
- Tunnels or crawl spaces
- Hazard often not apparent
- Areas with limited means of entry or exit
- Rescuing an employee is difficult

# Confined Space

- Must identify and label confined spaces
- Training on risk
- Prevent unauthorized entry
  - Students in tunnels?
- Confined space entry procedures
  - Permit
  - Air monitoring



## Asbestos Awareness

Health hazard commonly found in our environment today.

Employees aware and how to avoid exposure.

'Pre-1981' Some Ceiling tile, 9" floor tile, spray on fire retardant, pipe insulation, adhesives

Campus approaches

- “Manage in Place”
- Complete removal

Procedures to test: Abate by trained staff or license contractors

# Crystalline Silica

- Sand + Heat = Glass = small micro jagged bits = Crystalline Silica
- Extremely dangerous to lungs, eventually fatal upon continued, extended, uncontrolled ingestion
- Trigger for concern and awareness of abatement that leads to the Permissible Exposure Limit (PEL) 25  $\mu\text{g}/\text{m}^3$  over an 8 hour Time Weighted Average (TWA)



# Engineering Controls

- Water flows/Water Sprays
- Air exchange filtration systems
- Vacuum systems
- Partitions
- Cyclones
- Precipitators
- Positive pressure rooms / zones



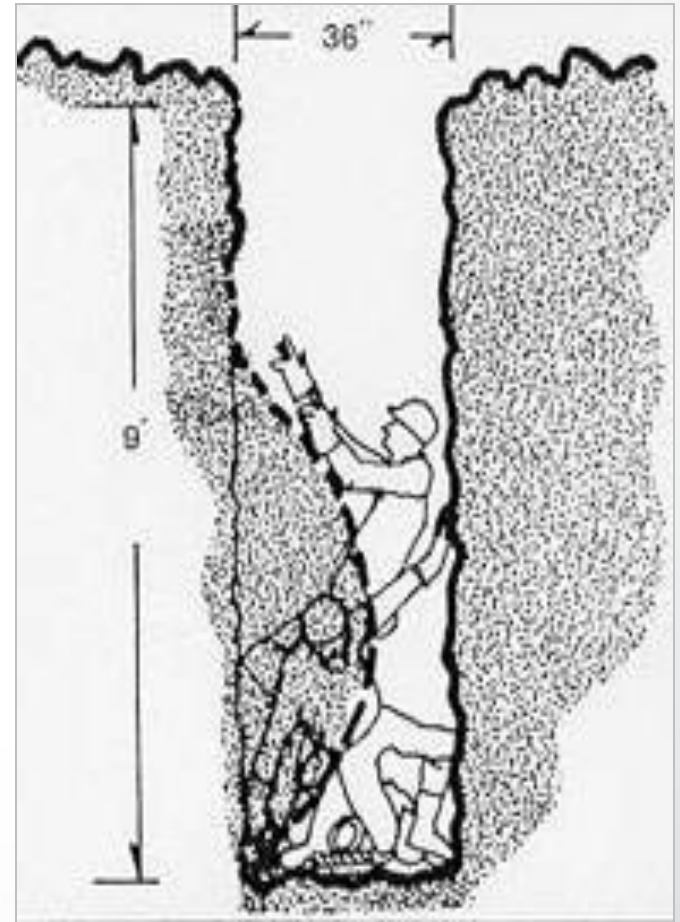
Picture courtesy of Robert Bosch Tool Corporation, North America





# Trenching and Excavations

- 29 CFR 1926 Subpart P
- Excavating is one of the most hazardous construction operations.
- Most accidents occur in trenches 5-15 feet deep.
- Usually no warning before a cave-in.





## Trench Excavation

- Competent Person and employee training
- Required if trench 4 feet or more in depth.
- Stairway, ladder, ramp, or other safe means of egress must be located in trench.
- Lateral travel distance no more than 25 feet.



# Steam Safety

- High pressure systems
  - Leaks may not be visible
- Proper initial construction and repairs
  - ‘Threaded rod’ is not a substitute for Bolts meeting ASTM Standards
  - Valve and flange pressure ratings
- Water Hammer
  - Condition when water suddenly flashes to steam and expands
- Highest risk during shut down or startup
  - Procedures for shut down and startup

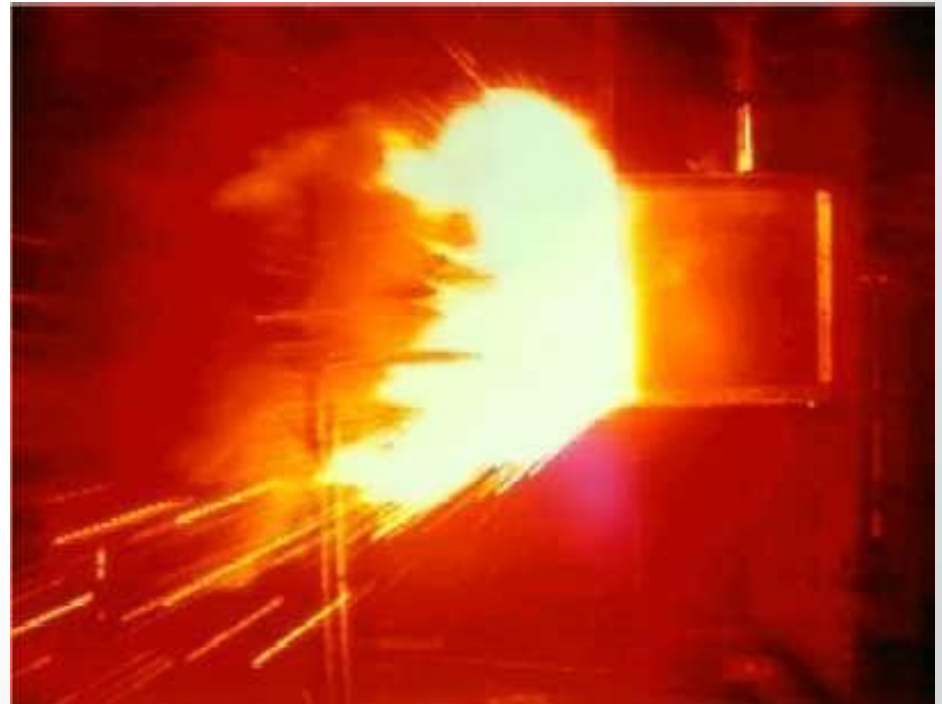
## Lock Out/Tag Out (LOTO) Program

- Employees trained and demonstrate how to lock out an energized source
- Each employee has his/her own lock
- All energy sources
  - Electrical, hot water, steam, compressed air, controls
- Equipment w/ multiple energy sources
- Appropriated devices to lock out



# Electrical Arc Flash Hazards

- Type of electrical explosion caused by connection to ground or other phase
- Vaporizes metal conductors & expands at high temperature



# Energized Electrical Work Permit (A Way)

- *Our Best Practice is to perform the work De-Energized.*

## Energized Work Permit

- Permits are specific to the job
- Allows for Pre-Job Briefing
- Identifies possible hazards and safety measures to be implemented
- Verifies no de-energized alternatives and that safe energized electrical work is reasonably possible
- Must be signed by employee and supervisor

## Arc Flash Incident - Background

- Carmichael Gym constructed in 1971
- Main Breaker original to the building
  - Westinghouse, HNC Frame, 3 pole, 1200 amp 600 VAC
  - Catalog #HHC31200F, Style #2608D76G17
- Breaker failed while being closed resulting in 2<sup>nd</sup> and 3<sup>rd</sup> degree burns to lower right arm of employee



# INCIDENT TIMELINE



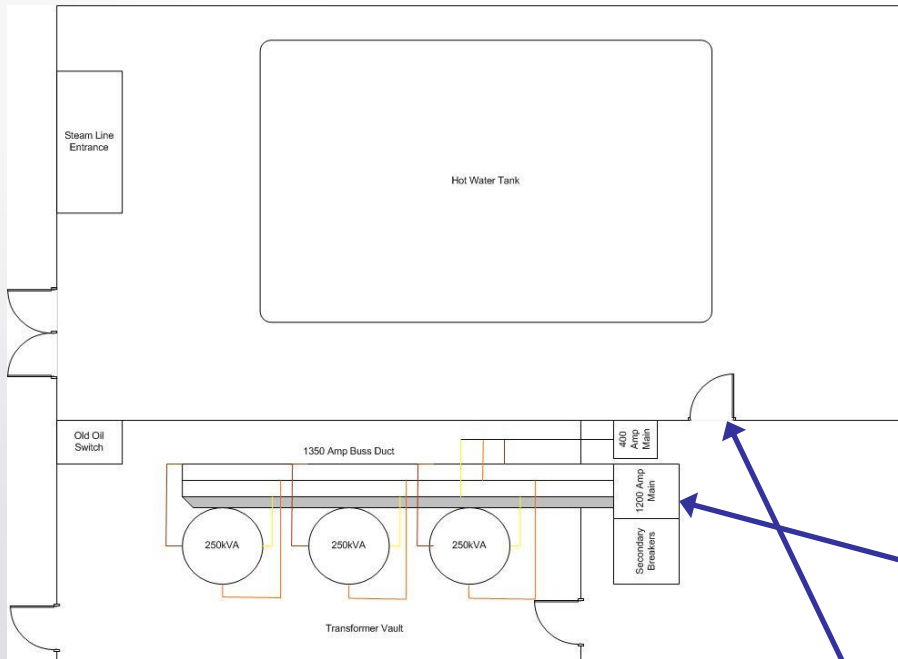
00:50 AM Call received by Power Systems On Call Technician - No Power Carmichael Gym. Responds and finds no problem with High Voltage Distribution system. Does find traffic light at Cates/Morrill out (light fed from Carmichael). Indicated that he requests Zone Technician be Called. No record of Zone 3 being called.

2:00 AM Call Received by Zone 7 On Call Technician – Street Lights Out Cates Ave. Technician responds investigates, but finds all street lights ‘ON’ as well as lights around Talley Construction site ‘ON’ around 3:00 AM.

5:55AM Campus Police Called Steam Plant – No Pwr Carmichael Gym. On call Bldg Technician calls supervisor approx. 6:15 am & reports issue

Approx. 0645AM Supervisor receives a call from Customer Service Center – No power at Carmichael. Supervisor receives call from OIT asking when power will be restored to Carmichael.

# TIMELINE



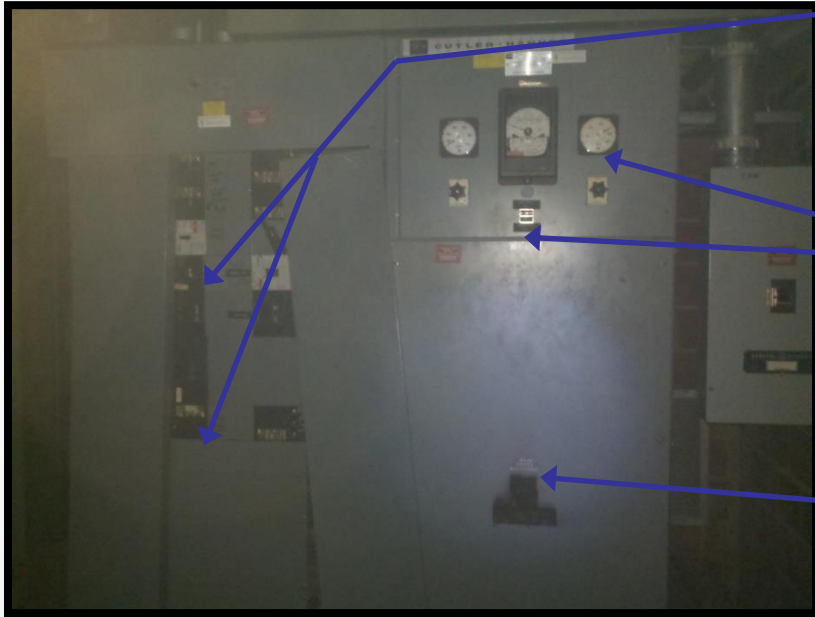
7:00 AM Supervisor Assembles team to respond (two technicians and Supervisor). Lead Tech takes another team to respond to other emergency call for Zone 3 - Fountain Dining reported stopped up drain.

7:05 AM Supervisor stopped by Talley Construction Site. Report that power flickered, but all Power ON.

7:15 AM Zone 3 Technician called BM&O Electrical Engineer, and he arrived at approximately 7:30 AM after Arc Flash incident occurred.

7:15 AM Shop Supervisor arrives at Carmichael to evaluate situation. Finds Main Breaker in the Tripped position.

7:20 AM Second Employee at Door. Holds flashlight for Supervisor to evaluate situation.



7:20 AM Shop Supervisor unloads breaker by opening all sub-breakers.

Checks Voltages: All Normal.  
Manual reset Shunt Trip ON, i.e. did not need to be reset.

7:25 am Shop Supervisor closes breaker. Breaker fails. Initially hears 'bacon frying' sound, turns away to exit room. Breaker failure creates an Arc Flash.

Shop Supervisor clears room and contacts Power distribution to isolate the Bldg at switch prior to Transformers.

7:45 am Supervisor unaware of the severity of his injury. Initially indicates medical treatment unnecessary. Supervisor returns to the Shop, where First Responders meet him. Ambulance takes Supervisor to UNC Burn Center .

## Breaker that Failed





# Category 3 PPE (31 cal/cm<sup>2</sup>)

600 volt Class equipment



MDP

# PPE (<1.2 cal/cm<sup>2</sup>)



MDP



## What is PPE?

- Equipment that creates a barrier against workplace hazards
- Examples include hard hats, goggles, gloves, hearing protection, etc.
- A temporary measure



# Hazard Assessment

- Requirement
  - Employer must select PPE based on the assessment and require employees to use them
  - Communicate selection decisions to employees
- Involve managers and employees
  - Impact
  - Penetration
  - Compression
  - Chemical
  - Heat/cold/wet
  - Harmful dust



## PPE Payment

- The employer must pay for replacement PPE unless it is lost or intentionally damaged.
- If the employer provides adequate and appropriate PPE, but the employee prefers a different type, the employer does not have to pay for it.

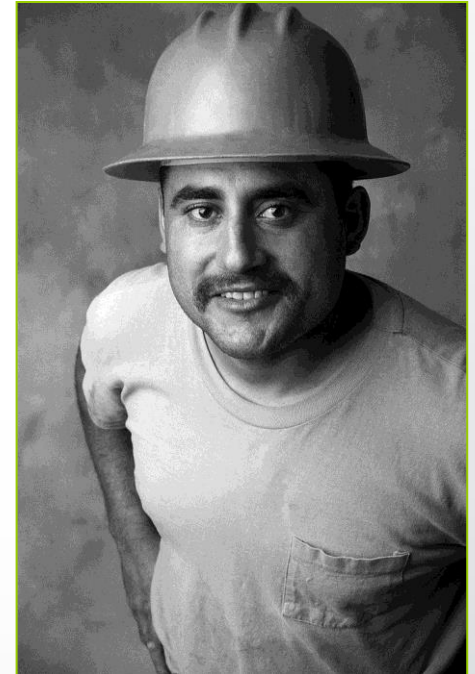
## Eye and Face Protection

- The employer shall ensure that each affected employee uses eye protection that provides side protection when there is a hazard of flying objects.
- Criteria for protective eye and face devices
  - ANSI Z87.1-2003
  - ANSI Z87.1-1989 (R-1998)
  - ANSI Z87.1-1989



# Head Protection

- General requirements
  - The employer shall ensure that each affected employee wears a protective helmet when working in areas where there is a potential for injuries to the head from falling objects.
- Criteria for protective helmets
  - ANSI Z89.1-2003
  - ANSI Z89.1-1997
  - ANSI Z89.1-198



## Foot Protection

- General requirements
  - Employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries.
- Criteria for protective footwear
  - ANSI Z41-1999
  - ANSI Z41-1991
  - ASTM F2412-05 and F2413-05





# Hand Protection

- General requirements
  - Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards.
    - Skin absorption
    - Cuts and lacerations
    - Abrasions
    - Burns
    - Temperature extremes

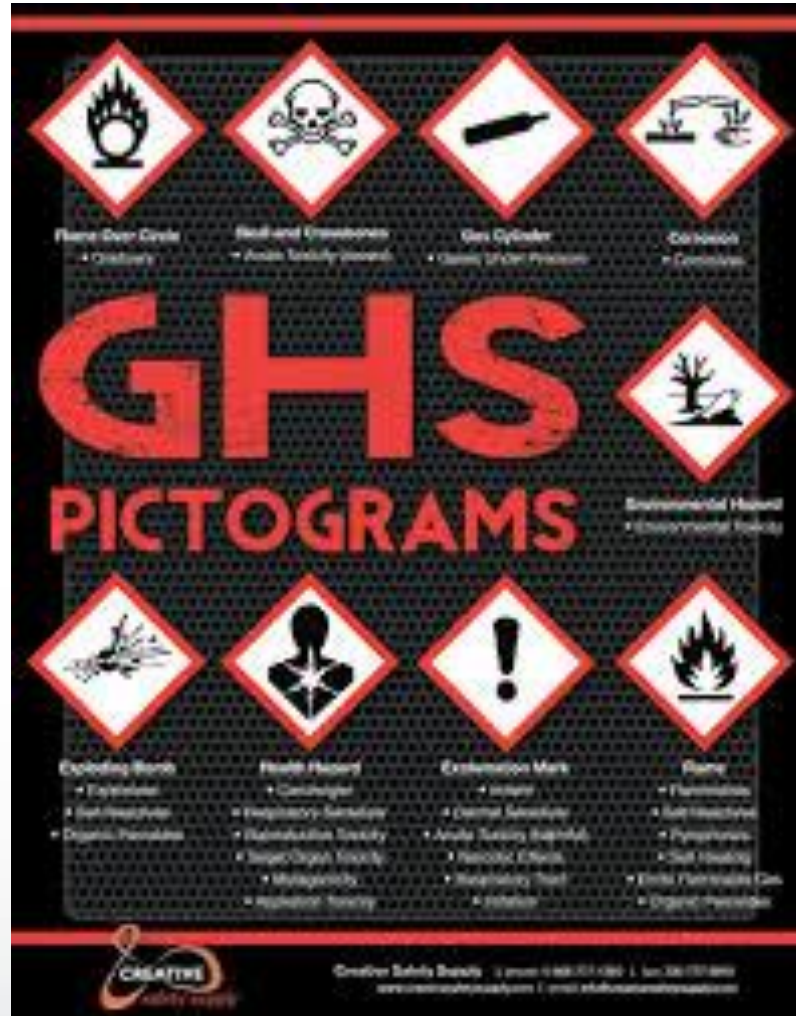


# EMPLOYEE RIGHT TO KNOW

- OSHA Hazard Communication Standard 1983
  - Aka “Employee Right to Know”
  - MSDS Sheets
  - Initial employee safety briefings – new hire
- OSHA Revised Communication Standard 2012
  - 29CFR1910.1200
  - Specific format/standard form
  - Globally Harmonized System (GHS) Format
  - United Nations Standard – Global economy
  - Employers required to provide training

# EMPLOYEE RIGHT TO KNOW

- Globally Harmonized System (GHS) Format



# **GOOD NEWS EMPLOYEE SAFETY STORY OR BEST PRACTICE**

**Discuss at your table, then share with  
group.**

# Best Safety Practices from Participants

- Tool Box Safety Meetings
  - Think before you act
  - Remember the risks, even if you have done the job before
- Participation
  - Each Person responsible for themselves and co-workers
  - Management involvement
- Technical experts to solve problems
- Mishap Review Board



# CAMPUS SAFETY

## VIRUSES (COVID-19, Monkeypox, etc.)

- HVAC System operations
  - Outdoor air
  - Filtration
  - Portable air purifiers
  - UV Lighting
- Cleaning procedures (normal vs. isolation)
- Wastewater testing

## CAMPUS FIRE SAFETY – Facilities Role

- Operations, Maintenance, and testing of Fire Alarm and Sprinkler systems
- Coordination with local Fire Marshal, Fire Protection, and Insurance Staff
- System Monitoring
  - Facilities Operations Center
  - Campus Police system
  - Off-Site Vendor



# PRIORITIES?

- According to the NFPA
  - 7% sprinkler system failures can be attributed to equipment
  - **67% of failures were due to the system being turned off (manual valve closed)**



- Sprinkler protects Facilities/Fire Alarm protects Lives
- Priorities are Housing/Dormitories, large gathering areas(Athletics) & Annual Tests



# BIO SAFETY

- Focus on Labs
- Work with microorganisms or biological material
- NIH - Biosafety in Microbiological and Biomedical in Research Laboratories
- Guide for Plant Biosafety in Research
- If you are a research institution, tied to funding

## Biohazard Symbol

Communication of hazards is a key component to any OSHA and other safety program.

The Biohazard symbol is used to alert others of the potential presence of biohazardous materials such as human blood, body fluids, and OPIM.

This symbol is fluorescent orange or red/orange with contrasting letters and has the universal biohazard symbol.



# Blood Borne Pathogen Awareness

- Pathogens contained in blood as well as other bodily fluids and Other Potentially Infectious Materials (OPIM)
- Risk and infections from the “Big Three”
  - hepatitis B virus (HBV)
  - hepatitis C virus (HCV)
  - human immunodeficiency virus (HIV)
- Spills and Waste Water systems

# Bloodborne Pathogens Spills



Spills may occur when an injured person drips blood on the floor, when sewage overflows, or when containers of human blood or other potentially infectious materials (OPIM) are dropped in the clinic or laboratory.

Facilities Staff designated and trained to participate in emergency and decontamination procedures are exposed to blood or materials

## Bloodborne Pathogens Spill Clean Up Kits Typically Include:



- 1 pair disposable latex gloves,
- 1 disposable faceshield,
- 1 disposable face mask,
- 1 pair disposable shoe covers,
- 1 disposable apron, 1 absorbent pack (w/ MSDS),
- 2 disposable towelettes (w/ MSDS),
- 2 scoops/scrapers,
- 2 biohazard bags with ties,
- 1 disposable towel,
- 1 instruction sheet,
- 1 can 12 oz. Disinfectant spray (w/ MSDS)



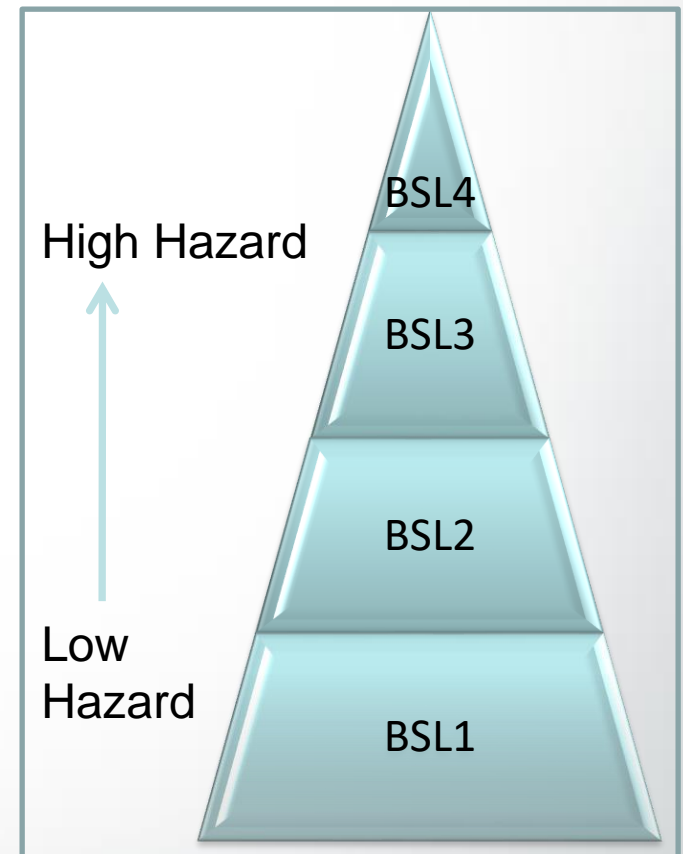
# Procedures and Precautions During a Spill Cleanup

Contaminated broken glassware is cleaned up by mechanical means (e.g. tongs, forceps, pieces of cardboard).



# BIO SAFETY

- Facilities - secondary barriers to containment
- Bio Safety Labs - Levels
  - Annual 3<sup>rd</sup> party Certifications for BSL-3 & BSL-4
  - Gown in and out
  - Use of Bio Safety Cabinets
- Basics
  - PPE, wash hands, don't eat
- Specific Mnt & cleanup procedures



# CAMPUS SAFETY – Lab Exhaust Systems

- Fume Hoods & Lab safety
- Mnt & Operations
- Certification Process
- Outage procedures



# Eye Washes & Safety Showers

- ANSI Z358.1
- Eye Wash
  - Test Weekly
- Safety Shower
  - Test annual



## CAMPUS SAFETY - Security

- Most campuses have developed or are developing comprehensive contingency plans
- Mass communications systems
- Cameras, signs, fences, card access, exterior lighting, obstructions, loss of power, etc.
- Security risks – Facilities involvement
  - Key control
  - Fuel storage tanks
  - Roof access
  - Data Centers
  - Web access/security

# ENVIRONMENTAL AFFAIRS



# Waste Management

- Municipal Waste - To landfill

Other Items can not be disposed of in a Landfill

- Recyclables
  - Metal, batteries, plastics, printer cartridges, etc.
- Building Demolition Debris
- Bio Waste
- Radio-active waste
- Chemical waste

# Hazardous Waste

- Resource Conservation and Recovery Act (RCRA)
- Universal Waste Rule
- Cannot dispose of hazardous waste in landfill
  - Facilities specific items
- Awareness when working in space where Facilities is not the generator
  - Chemistry department?

# Cluttered Work Area



## Hazardous Waste – General

- Orderly work area/good housekeeping
- Aisle Space (approx. 30")
- Container Selection
- Closed containers
- Filling containers (10% headspace)
- Secondary containment
- **Waste generator has responsibility for characterizing and labeling wastes**
- Container markings
- Emergency preparedness (leaks, phone numbers, etc.)

# Hazardous Waste – Mercury

- Mercury is a hazardous waste
  - Thermostats, thermometers
  - Fluorescent lamp recycling program
- All Fluorescent bulbs contain mercury ! Even Green Tip Bulbs!

*Straight Tubes*



*U-shape*



*CFL's*





# Proper Spent Lamp Storage and Accumulation





# Improper Storage



# **Hazardous Waste Contractor (cannot go to landfill nor in municipal sewer nor storm sewer)**

- Ballasts containing PCBs
- Batteries (many types, non-alkaline batteries)
- Cleaning chemicals
- Compressed gas cylinders
  - Or better purchase with a return agreement
- Oil & oil filters
- Paint and paint-related materials
- Pesticides

# Biological Waste

- Pathogen Containing Waste
  - Mostly associated with Hospitals or Vet Schools
  - Must be Incinerated
- Bio Waste
  - Auto Clave
  - Then to a permitted Landfill
  - Careful of transfer station requirements – some will not take autoclave waste

## ENVIRONMENTAL - Refrigerants

- Causes Ozone depletion in atmosphere
- AC systems and refrigerators
- Some refrigerants phased out
  - R- 12, R-11, R-22
  - Increase cost for replacement
- Recovering and reclaim procedures
- Handled by CFC qualified technicians
- Repair leaks
- Annual Reporting to EPA

## ENVIRONMENTAL – Waste Water

- Some campus operated Water and Wastewater Plants
  - Regulated and permitted by State
- Most campuses have some pre-treatment requirements with the municipality
  - Grease Traps
  - Acid neutralization from labs
  - Solids separators

## Indoor Air Quality (IAQ)

- General duty clause – Workplace must be free from RECOGNIZED hazards that are likely to cause death or serious physical harm
- IAQ Affects productivity, comfort, health and safety
- Can revolve around mold
- **If comfort issues are not resolved, they are perceived as health and safety problem and productivity will suffer!**



# Spill Prevention, Control, & Countermeasure (SPCC)

- Regulated by EPA
- More than 10,000 gallons of above ground storage
  - Plus other criteria
    - Central plant fuel tanks
    - Generators
- Purpose - Help prevent any discharge of oil into navigable waters or adjoining shorelines.
- Focus on prevention, but also response plan
  - Training, inspections, contingency plans

# CLEAN AIR ACT

- Air Permit
  - Reporting
  - Inspections
  - Training
- List of sources on campus
  - Mainly large utility plant
  - Emergency generators



# STORM WATER MANAGEMENT

- Are you subject to local municipality requirements
  - City of Raleigh Stormwater Management Advisory Commission (**Town and Gown relationships**)
  - “The SMAC will manage resources sufficiently to protect the public infrastructure, quality of life, environment, and property of the citizens of Raleigh through fair and equitable cost effective means. The SMAC recommendations will seek to improve, enhance, and protect the quality of the Neuse River.”
- Most campuses want to be seen as doing the right thing regarding stormwater

# STORM WATER MANAGEMENT

- Erosion and Sediment Control – land disturbance requirements
- Run off control/time of concentration
  - Retention ponds/Bio ponds
  - Green Roofs
- Stormwater best practices
  - Consider long term maintenance impacts



# SURVEY SHEETS QUESTIONS?

This concludes The American Institute of  
Architects Continuing Education  
Systems Course

