

General Information	2
Multiple Day Courses	3
Area Electrical Classification and Hazardous Area Wiring (20 hours).....	4
Pilot Plant Design, Construction and Operation (20 hours).....	6
Pilot Plant and Laboratory Safety (20 hours).....	8
Successful Pilot Plant and Laboratory Equipment Selection and Installation (20 hours)	10
Safe Operation of Pilot Plant and Laboratory Equipment and Systems (20 hours).....	13
Successful Laboratory Design: Grass Roots, Renovation, or Relocation (20 hours).....	15
Research Hazard Analysis and Risk Assessment in a Research Environment (16 Hours).....	17
Technical Fundamentals of Process Safety (16 hours)	18
Pumps and Process Piping (13 hours)	20
Single Day Courses	22
Area Electrical Classification For Class I Locations (8 hours).....	23
Area Electrical Classification for Pilot Plants, Laboratories and Research Facilities (8 hours) ...	24
Compressed Gas Piping for Research Applications (8 hours).....	25
Compressed Gas Safety: Code Compliance and Best Practices (8 hours).....	27
Credible Scenarios for Research Risk Assessments (8 hours).....	28
Hazard Identification (HAZID) in a Pilot Plants and Laboratories: What You Don't Know Can Hurt You (8 hours).....	29
Piping and Instrument Drawings (P&IDs) Demystified: What You Need to Know to Read, Create, and Use Them Effectively (6 hours).....	31
Selecting and Using Laboratory Hoods Safely (7 hours).....	32
Short Courses (less than 1 day).....	33
Compressed Gas Hazard Awareness And Basic Safety Training (4 hours).....	34
Credible Scenarios for Research Risk Assessments (4 hours).....	34
Hazard Identification in a Laboratory or Research Environment (4 hours).....	35
Electrical Safety in Research Environments (2 hours).....	35
Annual Hood Testing (4 hours)	36
Estimating Pilot Plant Costs (6 hours)	36
Pilot Plant Instrumentation Basics (4 hours).....	37

General Information

- There are no extra charges no matter how many people attend a training session.
- Both on-site and virtual courses are available.
- All courses are in modular format so selecting sections from different courses to make a custom course addressing major areas of concerns is easy.
- All courses can be geared to a specific audience level from crafts personnel or technicians to researchers and technical staff.
- Course durations can usually be modified to meet time and budget constraints by adding more relevant or removing less relevant materials.
- Alternate training approaches such as workshops, guided discussions, and moderated reviews are also available.
- Custom courses on numerous other topics can be developed once a general framework of what the course is to address is agreed upon.
- Combinations of consulting (safety, design, code compliance, area electrical classification, etc.) and training is available.
- Open Q&A sessions on selected topics are also possible.
- Scheduling options are available for non-consecutive training, off hours training, multiple sessions, or any other option desired.

Let me know what you need and I can find a way to address it effectively and efficiently.

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Multiple Day Courses

Area Electrical Classification and Hazardous Area Wiring (20 hours)

This course provides a comprehensive working knowledge of the methods to classify areas and the associated approved wiring methods. It is intended for all levels of personnel from managers to crafts people. This course focuses on plant scale equipment and operations. It is intended for new and experienced personnel

1. Flammability Basics

- a. Flash points
- b. Autoignition temperatures
- c. Explosion types
- d. Explosive Limits
- e. Inerting
- f. Oxygen enriched atmospheres
- g. Classification of flammable and combustible liquids

2. Class I Locations

- a. History of the code
- b. Overall definitions
- c. Class I locations
- d. Code examples
- e. Mitigating conditions
- f. Division 1 vs. Division 2
- g. Group determination
- h. T-Ratings
- i. IEC zone definitions
- j. Classes vs zones
- k. Class examples
- l. Guidance documents
 - i. OSHA
 - ii. NFPA-497
 - iii. API-520
 - iv. IEC
- m. Classification procedure
- n. Openings
- o. Ventilation
- p. Classification probabilities
- q. Miscellaneous issues

3. Class II and III Locations

- a. Class II locations
- b. Class III locations
- c. Dust hazard overview
- d. Industry guidelines
- e. NFPA-654 guidelines

<ul style="list-style-type: none"> f. Examples of dust hazards g. ISA Guidelines h. Guidance documents <ul style="list-style-type: none"> i. NFPA-499 ii. ISA-12.10 i. Discussion of specific problem areas
<ul style="list-style-type: none"> 4. Wiring Class I locations <ul style="list-style-type: none"> a. Approved wiring methods b. Enclosures c. Explosion proof wiring basics d. Conduit seals e. Seal requirements f. Process seals g. Flexible cords h. Equipment specifics
<ul style="list-style-type: none"> 5. Wiring Class II Locations <ul style="list-style-type: none"> a. Approved wiring methods b. Differences from Class I locations c. Enclosures d. Conduit seals e. Seal requirements f. Flexible cords g. Equipment specifics
<ul style="list-style-type: none"> 6. Other Wiring Methods <ul style="list-style-type: none"> a. Intrinsically safe wiring basics b. Non-Incendive wiring overview
<ul style="list-style-type: none"> 7. Purging and Pressurization <ul style="list-style-type: none"> a. Overview b. Pressurization requirements c. Implications for research operations d. Purged enclosure design considerations e. Control room design considerations f. Problem areas
<ul style="list-style-type: none"> 8. Maintenance and Inspection <ul style="list-style-type: none"> a. Inspection requirements b. Things to look out for c. Common maintenance issues
9. References
10. Q&A

Pilot Plant Design, Construction and Operation (20 hours)

This course focuses on the critical components for a successful pilot plant program. It is intended for pilot plant project managers, supervisors, designers and operators, as they design, build and operate pilot plants. It is suitable for all levels from inexperienced to very experienced.

1. Defining a Pilot Plant Program
 - a. What is a pilot plant?
 - b. Defining the goals of the pilot plant
 - c. Identifying key issues
 - d. Selecting the appropriate strategy
 - e. Developing a design basis
 - f. Prototype concerns and implications
2. Pilot Plant Design Issues and Strategies
 - a. Difference from process plants
 - b. Prototype concerns
 - c. Design approaches
 - d. Minimizing the downside risk
 - e. Design and construction options
 - f. Guidelines for successful contracting
 - g. Continuous vs. batch systems
 - h. Attended vs. unattended operation
 - i. Design hints
3. Types of Space Suitable for Pilot Plant Operations
 - a. Separate buildings
 - b. Containment cells
 - c. Open bays
 - d. Hoods and laboratory areas
 - e. Estimating pilot plant space requirements
4. Pilot Plant Cost Factors
 - a. Practical effects of budget constraints
 - b. Estimating design and construction costs
 - i. Similarity (standard)
 - ii. Similarity (adjusted)
 - c. Cost ratios
 - i. General
 - ii. Specific
 - d. Detailed labor and materials
 - i. Detailed labor with materials added
 - ii. Detailed materials with labor added
 - iii. Detailed labor and materials
 - e. Issues and concerns
 - f. Contingency
 - g. Accuracy
5. Schedule Factors

<ul style="list-style-type: none"> a. Major areas of concern b. Guidelines for effective scheduling c. Crash program risks d. Approaches to minimize problems e. Technology implications
<ul style="list-style-type: none"> 6. Pilot Plant Control Systems <ul style="list-style-type: none"> a. Types of control systems b. Estimating system size c. Maintenance and reliability d. Contracted vs. in-house maintenance e. Control system placement options f. Guidelines for successful control rooms g. Control vs. safety systems
<ul style="list-style-type: none"> 7. Pilot Plant Start-Up <ul style="list-style-type: none"> a. Differences from major process unit start-up b. Optimizing start up efforts c. Start-up resources d. Start-up sequences e. Equipment f. Calibration g. Turn-key vs. in-house start up h. Flushing i. Leak testing
<ul style="list-style-type: none"> 8. Pilot Plant Maintenance <ul style="list-style-type: none"> a. Advantages of good maintenance b. Types of maintenance c. How to minimize maintenance costs d. Typical maintenance costs e. In-house vs. contracted maintenance
<ul style="list-style-type: none"> 9. Operations <ul style="list-style-type: none"> a. Operating organization models b. Modifications vs. new construction c. Management of change d. On-line maintenance e. Coverage and shift issues f. Operational support
11. References
12. Q&A

Pilot Plant and Laboratory Safety (20 hours)

This course focuses on the key safety issues affecting pilot plant, laboratory, and research personnel whether in safety, managerial, technical, or operational roles. It gives a brief working knowledge of the specific safety-related codes and established best practices that govern safe operation. It is intended for new to experienced personnel.

1. Flammability Basics
 - a. Flash points
 - b. Autoignition temperatures
 - c. Explosion types
 - d. Explosive Limits
 - e. Inerting
 - f. Oxygen enriched atmospheres
 - g. Classification of flammable and combustible liquids
 - h. NFPA and OSHA issues
 - i. Hazard classifications
2. Safety reviews
 - a. Types of safety reviews and their purposes
 - b. Problems with safety reviews
 - c. Ensuring safety reviews meet their goals
3. Hazard Analysis and Risk Assessment
 - a. Generic hazard analysis
 - b. What if hazard analysis
 - c. HAZOP
 - d. Fault tree/event tree analysis
 - e. Failure modes, effects and criticality analysis
 - f. Risk assessment issues
4. Safety inspections
 - a. Types of safety inspections and their purposes
 - b. Problems with safety inspections
 - c. Developing an effective safety inspection program
5. Space Considerations
 - a. Types of research space
 - b. Safety considerations for each type of space
 - c. Interior vs exterior locations
 - d. Laboratory vs pilot plant areas
 - e. Barricades vs other measures
 - f. Barricade design and operational considerations
6. Code Compliance
 - a. Types of codes and its implications
 - b. Overview of common codes applicable to research operations
 - i. OSHA
 - ii. EPA
 - iii. Building codes

<ul style="list-style-type: none"> iv. NFPA v. ASME vi. Miscellaneous codes
<ul style="list-style-type: none"> c. Resolving Code Disputes
<ul style="list-style-type: none"> 7. NFPA-45: Safety in Laboratories Using Flammable Materials <ul style="list-style-type: none"> a. Overview b. Laboratory construction requirements c. Laboratory ventilation requirements d. Flammable liquid storage e. Miscellaneous requirements f. Implications for research operations
<ul style="list-style-type: none"> 8. NFPA-70: National Electric Code <ul style="list-style-type: none"> a. Overview b. Definitions of hazardous areas c. Determining hazardous areas d. Summary of hazardous area requirements
<ul style="list-style-type: none"> 9. NFPA-496: Purged and Pressurized Enclosures <ul style="list-style-type: none"> a. Overview b. Pressurization requirements c. Implications for research operations d. Purged enclosure design considerations e. Control room design considerations f. Problem areas
<ul style="list-style-type: none"> 10. NFPA-30: Flammable and Combustible Liquids Code <ul style="list-style-type: none"> a. Overview b. General requirements c. Containers d. Liquid storage e. Implications for research operations
13. References
14. Q&A

Successful Pilot Plant and Laboratory Equipment Selection and Installation (20 hours)

This course focuses on equipment selection, installation, and operating issues of interest to pilot plant and laboratory unit project managers, supervisors, designers, and operators. Its focus is for the less experienced design and operating personnel but is often very useful for more experienced individuals to broaden their knowledge base.

1. Piping and tubing
 - a. Piping basics
 - b. Materials specifications
 - c. Piping classes
 - d. Pressure-temperature ratings
 - e. Methods of joining pipe
 - f. Pipe sealants
 - g. Tubing basics
 - h. Pressure-temperature ratings
 - i. Compression fittings
 - j. Flare Fittings
 - k. High pressure fittings
 - l. Weldless fittings
 - m. Plastic pipe
 - n. Plastic tubing
 - o. Vacuum fittings
 - p. Copper tubing
 - q. Misc. issues

2. Valves
 - a. Ball valves
 - b. Plug valves
 - c. Globe valves
 - d. Metering valves
 - e. Gate valves
 - f. Butterfly valves
 - g. Sealless valves
 - h. Pinch valves
 - i. Check valves
 - j. Excess flow valves
 - k. Control valves
 - l. Solenoid valves
 - m. Manifolds
 - n. Sampling valves
 - o. Sight glass isolation valves
 - p. Cryogenic valves
 - q. Actuators
 - r. Regulating valves

<p>3. Seals</p> <ul style="list-style-type: none">a. Lip sealsb. Packingc. Mechanical sealsd. Double mechanical sealse. Sealless designsf. Sealless agitator issuesg. Gasketsh. O-Ringsi. Common problems and issues of each type of sealj. Design issues
<p>4. Pumps</p> <ul style="list-style-type: none">a. Centrifugalb. Meteringc. Progressive Cavityd. Tubinge. Diaphragmf. Sliding Vaneg. Flexible Impellerh. Turbinei. Screwj. Syringek. Rotary Lubel. Guidelines for Effective Pump Installationm. Pump Selection Criteria
<p>5. Reactor Mechanical Design Issues</p> <ul style="list-style-type: none">a. Pressure Ratingb. Reactor Closuresc. Commercial size reactorsd. Thermocouple Placemente. Bracketing/supportsf. Wall effectsg. Linings and coatingsh. Reactor internals
<p>6. Instruments</p> <ul style="list-style-type: none">a. Flow measurementb. Level measurementc. Pressure measurementd. Temperature measuremente. Specificationsf. Accuracy and precision
<p>7. Heat Tracing</p> <ul style="list-style-type: none">a. Electric heat tracingb. Steam heat tracingc. Hot oil heat tracingd. Heated enclosures

e. Guidelines and best practices
f. Insulation
g. High temperature protection
h. Electrically classified area issues
8. Pilot plant and laboratory unit layout
a. Different types of layout strategies
b. Examples of good and bad layouts
c. Guidelines for effective layouts
9. References
10. Q&A

Safe Operation of Pilot Plant and Laboratory Equipment and Systems (20 hours)

This course focuses on safety issues critical to the safe selection and operation of pilot plant and laboratory equipment. The course is intended to address often overlooked equipment hazards and offer practical guidance and recommendations for safe operations. It is intended for new to experienced personnel.

1. Gas Cylinder Safety
 - a. General principles
 - b. OSHA Requirements
 - c. NFPA 55 Compressed Gases and Cryogenic Fluids Code
 - d. Control areas and maximum allowable quantities
 - e. General requirements
 - f. Ventilation
 - g. Storage
 - h. Required separation distances
2. Cryogenic Systems
 - a. General Principles
 - b. NFPA 55 requirements
 - c. Overpressure
 - d. Safe Handling procedures
3. Relief Systems
 - a. Situations requiring over pressure protection
 - b. Sizing relief devices
 - c. Set pressures
 - d. Types of relief devices
 - e. Back Pressure considerations
 - f. Performance in research applications
 - g. Miscellaneous topics
 - h. Vent systems
4. Interlocks and Safety Systems
 - a. General considerations
 - b. Separation of safety and control systems
 - c. Types of interlocks
 - d. Safety system requirements
 - e. Layers of protection
 - f. Safety system reliability
 - g. Reliability levels
 - h. Field devices
 - i. Miscellaneous issues
5. The Safe Installation and Use of Glass Equipment in Pilot Plants, Laboratories, and Research
 - a. Basic considerations
 - b. Mounting
 - c. Guidelines for safe use

d. Glass and hazardous liquids
6. Hoods and Ventilated Enclosures <ul style="list-style-type: none"> a. Hood components b. What belongs in a hood? c. Hood testing d. Hood performance e. Canopies f. Snorkels g. Using hoods and ventilated enclosures safely
7. Piping Testing and Inspection <ul style="list-style-type: none"> a. Hydrostatic testing b. Leak testing c. Guidelines for safe testing
8. Flow Limiting Devices <ul style="list-style-type: none"> a. Types of flow limiting devices b. Advantages and disadvantages of each c. Applying flow limiting devices effectively
9. Gas Monitoring systems <ul style="list-style-type: none"> a. Basic types b. Sensor placement issues c. System design issues d. Guidelines for effective systems
10. Sight Glass Safety <ul style="list-style-type: none"> a. Types of sight glasses b. Mounting concerns c. Guidelines for safe use of sight glasses
11. Rotating Equipment: Compressors, Pumps, and Mixers <ul style="list-style-type: none"> a. Compressors b. Pumps c. Mixers
12. Heated Equipment Safety <ul style="list-style-type: none"> a. Ovens and Furnaces b. Heat Tracing c. Over Temperature Protection d. Heaters in Electrically Classified Areas

Successful Laboratory Design: Grass Roots, Renovation, or Relocation (20 hours)

This course focuses on the codes, systems, and layouts involved in designing or renovating a research laboratory. It assumes the participant will be involved at the interface with the design firm. It is intended to give a brief working knowledge of the issues so that the personnel involved can ask more intelligent questions, evaluate competing designs and develop a design suited to the organization's needs.

1. General Overview of Laboratory Design

- a. Common problems
- b. Guidelines for successful design
- c. Budgetary estimates

2. Codes Affecting Laboratory Design

- a. OSHA
- b. EPA
- c. Building codes
- d. Fire codes
- e. ASME
- f. NFPA-45
- g. NFPA-30
- h. Flammable storage issues

3. Types of Ventilation Systems

- a. General ventilation requirements
- b. NFPA-45 requirements
- c. Exhaust rates
- d. Pressurization
- e. Ventilation types
- f. Re-entrainment
- g. Ventilation issues

4. Hoods

- a. How hoods operate
- b. Placement criteria
- c. Common placement problems
- d. Usage criteria
- e. Common usage problems
- f. Ductless hoods
- g. Low flow hoods
- h. Auxiliary air hoods
- i. Miscellaneous ventilation issues

5. Safety Systems

- a. Common types of systems
- b. Issues to be addressed

6. Egress

- a. Code requirements
- b. Issues

7. Utilities and Fit Out
a. Common utilities
b. Utility placement and routing
c. Drain lines
d. High purity systems
e. Power requirements
f. Telecommunications
g. Computing
h. Evaluating designs
8. Finishings
a. Casework
b. Floors
c. Ceilings
d. Wall coverings
e. Doors
f. Evaluating systems to meet requirements
9. Common Laboratory Layouts
a. General types
b. Advantages and disadvantages
c. Discussion
10. Flammable Liquid Storage
a. Common problems
b. Potential solutions, advantages, and disadvantages
11. Grassroots vs Renovations
a. Advantages and disadvantages
b. Potential cost issues
c. Renovation strategies

Research Hazard Analysis and Risk Assessment in a Research Environment (16 Hours)

This course focuses on how to do hazard analysis and risk assessment in a research environment. Extensive class examples allow the students to understand the actual process. It is intended for all levels of personnel from managers to crafts particularly for those with less experience or less familiarity with hazard analysis in a research environment.

1. Hazard Analysis Fundamentals

- a. Overview
- b. Basic principles
- c. Common problems
- d. Guidelines for effective reviews

2. Hazard Analysis and Risk Assessment

- a. Generic hazard analysis
- b. What if hazard analysis
 - i. Class example
- c. HAZOP
 - i. Class example
- d. Fault tree/event tree analysis
 - i. Class example
- e. Failure modes, effects and criticality analysis

3. Risk Assessment

- a. Risk perception
- b. Risk perception factors
- c. Risk matrixes
- d. Tips for effective risk assessment
- e. Human error
- f. Hazard control hierarchy
- g. Guidelines for effective risk assessment
- h. Class example

Technical Fundamentals of Process Safety (16 hours)

This course focuses on the technical basis for process safety. It is intended to give a working background of the technical reasons for safety concerns to allow the student to understand the safety issues by improving and widening their background knowledge. It is intended for all levels of personnel including managers, sales personnel, crafts workers, and operators. The course focuses on those with limited technical background or experience.

1. Materials Properties

- a. Standard conditions
- b. Density
- c. Viscosity
- d. Freezing point
- e. Melting point
- f. Boiling point
- g. Pour point
- h. Pressure

2. Flammability Basics

- a. Flash points
- b. Autoignition temperatures
- c. Explosion types
- d. Explosive Limits
- e. Inerting
- f. Oxygen enriched atmospheres
- g. Classification of flammable and combustible liquids

3. Dusts

- a. Dust hazards
- b. Conditions required for an explosion
- c. Dust/Gas mixtures
- d. Explosion venting
- e. Dust behavior
- f. Dust codes

4. Reactive Materials

- a. Definition
- b. Types of hazards
- c. Common safeguards
- d. Overpressure protection
- e. Thermal runaway
- f. A bad example: T2 laboratories
- g. System safeguards
- h. Oxygen service

5. Toxicity and Chemical Exposure

- a. Definitions

<ul style="list-style-type: none"> b. Major types of exposures c. Key issues d. Exposure paths e. Hierarchy of Protection f. PPE g. Allowable limits
<p>6. Hazard Analysis and Risk Assessment</p> <ul style="list-style-type: none"> a. Generic hazard analysis b. What if hazard analysis c. HAZOP d. Fault tree/event tree analysis e. Failure modes, effects and criticality analysis f. Risk assessment issues
<p>7. Interlocks and Safety Systems</p> <ul style="list-style-type: none"> a. General considerations b. Separation of safety and control systems c. Types of interlocks d. Safety system requirements e. Layers of protection f. Safety system reliability g. Reliability levels h. Field devices i. Misc. issues
<p>8. Over Pressure Protection</p> <ul style="list-style-type: none"> a. Relief device sizing b. Relief device setting c. Relief device types
<p>9. Code Compliance</p> <ul style="list-style-type: none"> a. Types of codes and its implications b. Overview of common codes applicable to research operations c. OSHA d. EPA e. Building codes f. NFPA g. ASME h. Misc. codes i. Resolving Code Disputes
<p>10. Gas Monitoring systems</p> <ul style="list-style-type: none"> a. Basic types b. Sensor placement issues c. System design issues d. Guidelines for effective systems

Pumps and Process Piping (13 hours)

This course covers the equipment and procedures used to move fluids – liquids and gases – through an industrial process environment. This course covers the basic concepts and practical methods necessary to design, specify, evaluate, and troubleshoot industrial pump and process piping systems.

All relevant formulas and calculations are presented and demonstrated. Practical guidance for equipment selection is provided. It is intended for new or less experienced personnel or those whose training was not primarily in this area.

1. Basics of Fluid Flow

- a. Basic properties
 - i. Pressure
 - ii. Density
 - iii. Viscosity
- b. Reynolds number
- c. Pressure drop in liquid systems
- d. Pressure drop in gaseous systems
- e. Pressure drop through nozzles and orifices
- f. Choked flow
- g. Ideal Gas Law
- h. Non-ideal gases

2. Piping Basics

- a. Piping components, schedules, and categories per code
- b. Pipe sizing
- c. Pressure and temperature limitations
- d. B31.3 considerations
- e. Materials of construction

3. Valves

- a. Ball valves
- b. Plug valves
- c. Globe valves
- d. Metering valves
- e. Gate valves
- f. Butterfly valves
- g. Diaphragm valves
- h. Pinch valves
- i. Backflow prevention valves
 - i. Check valves
- j. Advantages and disadvantages

4. Control Valves

- a. Sizing for liquid flow
- b. Sizing for gas flow
- c. Tuning constants

5. Pump Selection and Installation

- a. Pump characteristics

<ul style="list-style-type: none"> <ul style="list-style-type: none"> i. Capacity ii. Head iii. Efficiency b. Pump power c. Pump classifications <ul style="list-style-type: none"> i. Operation ii. Purpose
<ul style="list-style-type: none"> 6. Types of Pumps <ul style="list-style-type: none"> a. Centrifugal pump b. Positive displacement pump c. Metering pump d. Gear pump e. Flexible impeller pump f. Sliding vane pump g. Turbine pump h. Progressive cavity pump i. Screw pump
<ul style="list-style-type: none"> 7. Pump Essentials <ul style="list-style-type: none"> a. NPSH b. Pump laws c. Motor sizing d. Pump selection criteria e. Advantages and disadvantages f. Installation tips g. Rules of Thumb
<ul style="list-style-type: none"> 8. Seals and Gaskets <ul style="list-style-type: none"> a. Packing b. Single mechanical seals c. Double mechanical seals d. Sealless e. Guidelines for proper seal selection f. Materials of construction g. Installation tips
<ul style="list-style-type: none"> 9. System Design <ul style="list-style-type: none"> a. How to design a piping system step-by-step b. Safety considerations

Single Day Courses

Area Electrical Classification For Class I Locations (8 hours)

This course provides training for personnel on the principles of area electrical classification for Class I locations (gases and vapors). It reviews the basic principles involved and explains the effect of ventilation, gas detection, doors, and numerous other common issues giving practical guidance. It is intended for both new and experienced personnel.

1. Introduction
2. Overall definitions
3. Class I locations
4. Code examples
5. Mitigating conditions
6. Division 1 vs. Division 2
7. Group determination
8. T-Ratings
9. IEC zone definitions
10. Classes vs zones
11. Class examples
12. Guidance documents
 - a. OSHA
 - b. NFPA-497
 - c. API-520
 - d. IEC
13. Classification procedure
14. Openings
15. Ventilation
16. Classification probabilities
17. References
18. Open Q&A

Area Electrical Classification for Pilot Plants, Laboratories and Research Facilities (8 hours)

This course focuses on problems encountered in trying to apply the National Electric Code in a research environment. The course assumes some familiarity with the code although a brief refresher is provided. It is intended for both new personnel, to acquaint them with the issues, and for experienced personnel, to suggest some potential solutions. Realistic, practical suggestions are provided that are applicable in a research environment.

1. Basic Principles Refresher
 - a. Flash point
 - b. Autoignition temperature
 - c. Explosive limits
2. Area Electrical Classification Refresher
 - a. Class I areas only
3. Common Codes and Standards
 - a. How they address research concerns
4. Adequate Ventilation
 - a. Definitions
 - b. Issues
5. Laboratory Classification and Issues
 - a. Hoods
 - b. Benches
 - c. Ventilated enclosures
 - d. Laboratory pilot plants
6. Approvals for Equipment
 - a. Use of IEC zone equipment
7. Heaters and Heat Tracing in Classified Areas
 - a. Purging
 - b. Limiting surface temperatures
 - c. Purchased units
 - d. Heat tracing
8. Process Seals
9. Flexible Connections
10. Combustible Gas Detection
 - a. how it affects area electrical classification
11. Purging and Pressurization

Compressed Gas Piping for Research Applications (8 hours)

This course focuses on training research personnel on how to pipe and use compressed gases in a research environment safely and effectively. It is intended for both new and experienced personnel.

1. Introduction
2. Compressed gas definitions
3. Compressed gas cylinder information
 - a. Markings and what they mean
 - b. Classifications
 - c. Misc. useful info
4. How many compressed gas cylinders can you have in a laboratory?
 - a. Maximum allowable quantities (MAQ's)
 - b. NFPA 45 restrictions
5. Where can you store compressed gases safely?
 - a. Mandatory separations
 - b. Gas cabinets (briefly)
 - c. Gas rooms (briefly)
 - d. Storage areas
 - e. Securing and security
6. Ventilation the key to safety
7. Common Problems
 - a. Impingement
 - b. Securing
 - c. Temperature limitations and heating
 - d. Protection from hazards
 - e. Leaking Cylinders
 - f. Purging piping
8. How to move compressed gas cylinders safely
9. How to use compressed gas cylinders safely
 - a. Allowable construction
 - b. Signs and labeling
 - c. Transferring and transfilling gases
 - d. Cylinder valves
 - e. CGA fittings
 - f. Connecting Cylinders
10. How to pipe gases safely
 - a. Materials of construction
 - b. Piping connections
 - c. Sealants
 - d. Pipe runs and supports
 - e. Tubing pressure and temperature rating
 - f. Tubing: how to select, install, and use it

g. Hoses and plastic tubing
h. Hydrostatic and Leak testing
11. Recommended piping
a. Symbology and eqpt
b. Specific P&ID Drawings
c. Pictures (good and bad)
d. Misc. Issues
e. Special cases
12. Accidents
13. References
14. Open Q&A

Compressed Gas Safety: Code Compliance and Best Practices (8 hours)

This course presents the regulations for safely handling compressed gas cylinders. The course focuses on minimizing the risks associated with cylinders, from receiving to storage to use. It is intended for both new personnel, to acquaint them with the issues, and experienced personnel, to identify problem practices and concerns.

1. What is a compressed gas?
2. Compressed gas containers and specifications
3. OSHA Requirements
 - a. OSHA 29 CFR 1910.101
 - b. OSHA 29 CFR 1910.253 Oxygen-Fuel Gas Welding and Cutting
 - c. OSHA 29 CFR 1910.102 (Acetylene)
 - d. OSHA 29 CFR 1910.103 Hydrogen Gaseous Systems
4. DOT Guidelines
5. CGA P-1 CGA P-1 Safe Handling of Compressed Gases in Containers
 - a. General Precautions
 - b. Safe Handling of Containers
 - c. Storage
 - d. Connecting containers
 - e. Flammable Gases
 - f. Corrosive and Toxic Gases
 - g. Asphyxiant Gases
 - h. Oxidizing Gases
6. NFPA 55 Compressed Gases and Cryogenic Fluids Code
 - a. Control areas and maximum allowable quantities
 - b. General requirements
 - c. Ventilation
 - d. Storage
 - e. Required separation distances
 - f. Container safety and operations
 - g. Cleaning and purging
 - h. Specific gas requirements
7. Good engineering practices
8. Special cases
 - a. Acetylene
 - b. Oxygen
 - c. Hydrogen

Credible Scenarios for Research Risk Assessments (8 hours)

This course trains people how to evaluate a hazard in a way that allows them to assess if the risk needs to be addressed or is acceptable. It teaches a method to assist in more realistically and accurately determining the probability of an incident occurring, allowing a more informed risk assessment. It is intended for both new to experienced personnel.

1. Introduction
2. Risk assessment Issues
3. Risk matrix issues
4. Defining a credible scenario
5. Class Problem 1: Developing scenarios
6. Class Problem 2: Determining which are credible
7. Class Problem 3: Determining the risk

Hazard Identification (HAZID) in a Pilot Plants and Laboratories: What You Don't Know Can Hurt You (8 hours)

This extended course focuses on how to identify hazards so that research personnel can more effectively plan to avoid incidents and accidents. It is intended for both new personnel to give them a firm starting basis for potential hazards and best practices and for experienced personnel to identify hazards often overlooked or ignored.

1. Basic Principles Refresher – Flammability Basics
 - a. Flash point
 - b. Autoignition temperature
 - c. Flammability limits
 - d. Effects of temperature, pressure, and oxygen
 - e. Liquid classification
 - f. Grounding
2. Over-Pressure Hazards
 - a. Common causes
 - b. Methods for over-pressure protection
 - c. Vent systems
3. Over-Temperature and Heating Hazards
 - a. Common causes
 - b. Cooling systems issues
 - c. Protection methods
 - d. Problems with purchased and fabricated equipment
4. Plastic Hose Issues
 - a. Common failure modes
 - b. Specific problem areas
5. Pressure Gauges
6. Leakage
 - a. Common causes
 - b. Leak testing
 - c. Avoiding leaks
7. Spills
 - a. Common causes
 - b. Spill protection
8. Glass Equipment
 - a. Guidelines for safe use
9. Pumps and Mixers
 - a. Common failure modes
 - b. Pump issues
 - c. Mixer issues
10. Oxygen-Enriched Atmospheres
 - a. Types of hazards
 - b. Common issues

<ul style="list-style-type: none"> c. Guidelines for effective installation
<ul style="list-style-type: none"> 11. Gas Cylinders <ul style="list-style-type: none"> a. Codes and standards b. Storage c. Guidelines for safe operation
<ul style="list-style-type: none"> 12. Interlocks and Safety Systems <ul style="list-style-type: none"> a. Common issues b. Hierarchy of Protection c. Guidelines for safe design and use
<ul style="list-style-type: none"> 13. Hoods and Ventilated Enclosures <ul style="list-style-type: none"> a. Common problem area b. Guidelines for safe operation
<ul style="list-style-type: none"> 14. Toxicity Overview <ul style="list-style-type: none"> a. Exposure Paths b. Hierarchy of protection c. Controls

Piping and Instrument Drawings (P&IDs) Demystified: What You Need to Know to Read, Create, and Use Them Effectively (6 hours)

This course teaches all levels how to prepare and read piping and instrument drawings. It is intended for all experience levels.

1. Types of engineering drawings and their purpose
 - a. Block flow diagrams (BFD)
 - b. Process Flow Diagrams (PFD)
 - c. Piping and Instrumentation Drawings (P&IDs)
2. P&ID symbology
 - a. ANSI/ISA-5.1 Instrumentation Symbols and Identification
 - b. PIP PICOO1 Piping and Instrumentations Diagram Documentation
3. Symbols and Their Functions
4. Line specifications
5. Valve symbols
6. Specialty symbols
7. Other common elements
8. Common problems, issues, and FAQs
9. Class exercise

Selecting and Using Laboratory Hoods Safely (7 hours)

This course provides working knowledge of how laboratory hoods operate, available hood options, relevant codes, and how hood selection impacts hood operation. A brief discussion of ventilated enclosures and local exhaust is included to highlight their differences. This course is designed for anyone who works in a laboratory or those new to the laboratory environment.

10. Code Requirements

- a. OSHA
- b. NFPA-45 Fire Protection for Laboratories Using Chemicals
- c. AIH Z9.5 Laboratory Ventilation

11. Basic Ventilation Systems

- a. Fixed volume
- b. Variable volume

12. Hoods

- a. Hood components
- b. Airfoils
- c. Bypass grills
- d. Sash types and their advantages and disadvantages
- e. Auxiliary air systems and their issues

13. Hood Alarms

- a. Code requirements
- b. Common problems and their solutions

14. Hood Testing and Certification

- a. ASHRAE 110 Methods of Testing Performance of Laboratory Hoods
- b. Review of the testing methods
- c. Issues with each methods

15. Using Hoods Safely

- a. Limiting hood openings
- b. Overcrowding
- c. Storage
- d. Depth of hood
- e. Fire and explosion potential
- f. Blast resistance

16. Hood Alternatives and Their Issues

- a. Ventiladed enclosures
- b. Local exhaust
- c. Ductless hoods
- d. Laminar flow hoods

Short Courses (less than 1 day)

Compressed Gas Hazard Awareness And Basic Safety Training (4 hours)

This course focuses on training personnel on how to develop credible risk scenarios. It is a shorter version of the one day course with only one class example and no class problems.

1. Introduction
2. Gas Cylinder Safety
3. General principles
4. OSHA Requirements
5. NFPA 55 Compressed Gases and Cryogenic Fluids Code
6. Control areas and maximum allowable quantities
7. General requirements
8. Ventilation
9. Storage
10. Required separation distances
11. References
12. Q&A

Credible Scenarios for Research Risk Assessments (4 hours)

This course focuses on training personnel on how to develop credible risk scenarios. It is a shorter version of the one day course with only one class example and no class problems.

13. Introduction
14. Risk assessment Issues
15. Risk matrix issues
16. References
17. Q&A

Hazard Identification in a Laboratory or Research Environment (4 hours)

This course focuses on identifying hazards so that research personnel can more effectively plan to avoid accidents. It is a shorter version of the 8 hour course that focuses on laboratory operations.

1. Basic principles refresher
2. Over pressure hazards
3. Over temperature and heating hazards
4. Plastic hose issues
5. Leakage
6. Spills
7. Glass equipment
8. Pumps and mixers

Electrical Safety in Research Environments (2 hours)

This course is a general awareness training course for research personnel on general electrical safety. It is intended for both new and experienced personnel. It is not an arc flash training course.

1. Introduction
2. General safety precautions
3. GFCI requirements, testing, and use
4. Grounding
5. Ignition source concerns
6. Cords, temporary wiring and plug strips
7. Preventing shocks and electrocution
8. Arc Flash Overview
9. Storage
10. High Voltage Laboratory Equipment Safety
11. Mandatory Clearances
12. References
13. Q&A

Annual Hood Testing (4 hours)

This course provides training for research personnel on how hood inspections and testing should be performed and discusses problems that arise, giving practical solutions. It is intended for both new and experienced personnel including maintenance personnel and their supervisors.

1. Introduction
2. Hood components and operation
3. Sash types
4. NFPA 45 requirements
5. ASHRAE 110 requirements
6. ASHRAE 110 face velocity testing
7. Pass/Fail requirements
8. Hood alarms
9. Tracer gas testing
10. Flow visualization
11. Causes of problems
12. References
13. Q&A

Estimating Pilot Plant Costs (6 hours)

This course provides training for research personnel on how to estimate the costs for a new or modified pilot plant or laboratory unit and avoid the problems that often arise. It discusses the different methods with their advantages and disadvantages and offers practical guidelines and suggestions for avoiding a bad estimate. It is intended for both new and experienced personnel.

1. Introduction
2. Overall Issues
3. Estimate Classes
4. Estimate Methodologies: Similarity
5. Estimate Methodologies: Cost Factors
6. Estimate Methodologies: Detailed Time and Materials
7. Contingency
8. Estimate Accuracy
9. Operating Costs
10. Start Up Costs
11. References
12. Q&A

Pilot Plant Instrumentation Basics (4 hours)

This course provides training for research personnel on the different types of instrumentation commonly use. It identifies the issues with each and gives practical guidance on selection and installation for success. It is intended for both new and experienced personnel.

1. Introduction
2. Flow measurement
3. Level measurement
4. Pressure measurement
5. Temperature measurement
6. Specifications
7. Accuracy and precision
8. References
9. Q&A