Mission
Lead the integration of process safety – through education, research, and service – into learning and practice of all individuals and organizations.

Vision
Serve as the Process Safety Center of Excellence that promotes:

❖ Process safety as a personal value that is second nature for all stakeholders
❖ Continuous progress toward zero injuries and elimination of adverse impacts on the community.

Values
❖ Health and safety of the community and the workforce
❖ Sharing of knowledge and information
❖ Sound scholarship and academic freedom
❖ Diversity of thought and viewpoint
❖ Independence to practice sound science
❖ Integrity of science validated by peer review
❖ Freedom to evaluate and comment on public policy
❖ Progress without undue influence by special interests
❖ Individual and group achievement
<table>
<thead>
<tr>
<th>Course Number</th>
<th>Title</th>
<th>Page Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Continuing Education Program</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Continuing Education (CE) Course Descriptions</td>
<td></td>
</tr>
<tr>
<td>1011</td>
<td>Combustible Dust Explosion Hazard Awareness</td>
<td>8</td>
</tr>
<tr>
<td>1022</td>
<td>HSE Management for Small &amp; Medium-Sized Businesses</td>
<td>9</td>
</tr>
<tr>
<td>1032</td>
<td>Loss Prevention for the Process Industry—Fundamentals</td>
<td>10</td>
</tr>
<tr>
<td>1041</td>
<td>Management of Change (MOC)</td>
<td>12</td>
</tr>
<tr>
<td>1052</td>
<td>Offshore Safety Engineering</td>
<td>13</td>
</tr>
<tr>
<td>1062</td>
<td>Pipeline Risk Assessment</td>
<td>16</td>
</tr>
<tr>
<td>1071</td>
<td>Process Safety for Managers and Executives</td>
<td>18</td>
</tr>
<tr>
<td>1082</td>
<td>Process Safety Management—Fundamentals</td>
<td>19</td>
</tr>
<tr>
<td>1093</td>
<td>Process Safety Management for Petroleum Production</td>
<td>21</td>
</tr>
<tr>
<td>1102</td>
<td>Security for the Chemical Process Industry</td>
<td>23</td>
</tr>
<tr>
<td>1113</td>
<td>SEMP for Offshore Oil &amp; Gas Operations and Facilities</td>
<td>24</td>
</tr>
<tr>
<td>1122</td>
<td>Serious Incident Prevention—For Operating Managers and Safety Professionals.</td>
<td>26</td>
</tr>
<tr>
<td>1131</td>
<td>SHE Management System—Implementing &amp; Optimizing (one-day)</td>
<td>27</td>
</tr>
<tr>
<td>1132</td>
<td>SHE Management System—Implementing &amp; Optimizing (two-day)</td>
<td>28</td>
</tr>
<tr>
<td>1141</td>
<td>What Went Wrong? Learning from Chemical Plant Incidents (one-day)</td>
<td>29</td>
</tr>
<tr>
<td>1142</td>
<td>What Went Wrong? Learning from Chemical Plant Incidents (two-day)</td>
<td>31</td>
</tr>
<tr>
<td>1152</td>
<td>HAZID</td>
<td>33</td>
</tr>
<tr>
<td>2013</td>
<td>Auditing Your SHE Management System</td>
<td>34</td>
</tr>
<tr>
<td>2022</td>
<td>Consequence Analysis—An Introduction</td>
<td>35</td>
</tr>
<tr>
<td>2032</td>
<td>HAZOP Expert System</td>
<td>36</td>
</tr>
<tr>
<td>2042</td>
<td>Layer of Protection Analysis (LOPA)</td>
<td>37</td>
</tr>
<tr>
<td>2052</td>
<td>Process Hazard Analysis Leadership Training</td>
<td>39</td>
</tr>
<tr>
<td>2062</td>
<td>Safety &amp; Health Auditing</td>
<td>40</td>
</tr>
<tr>
<td>2072</td>
<td>Safety Instrumented Systems (SIS) Implementation</td>
<td>41</td>
</tr>
<tr>
<td>2082</td>
<td>Safety Integrity Level (SIL) Verification</td>
<td>44</td>
</tr>
<tr>
<td>2092</td>
<td>Incident Investigation</td>
<td>46</td>
</tr>
<tr>
<td>2102</td>
<td>Process Safety Auditing</td>
<td>47</td>
</tr>
<tr>
<td>2111</td>
<td>Safeguarding Memoranda and Process Safeguarding Flow Scheme (MOC)</td>
<td>48</td>
</tr>
<tr>
<td>Code</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>3012</td>
<td>Coaching to Meet the Press and Other Hostile Audiences</td>
<td>49</td>
</tr>
<tr>
<td>3022</td>
<td>Engineering Design Practices for Safer Process Plants</td>
<td>50</td>
</tr>
<tr>
<td>3032</td>
<td>Facility Siting</td>
<td>51</td>
</tr>
<tr>
<td>3042</td>
<td>Hazard Assessment</td>
<td>54</td>
</tr>
<tr>
<td>3052</td>
<td>IEC Regulations</td>
<td>56</td>
</tr>
<tr>
<td>3062</td>
<td>Inherently Safer Design</td>
<td>57</td>
</tr>
<tr>
<td>3072</td>
<td>ISA 8401</td>
<td>58</td>
</tr>
<tr>
<td>3082</td>
<td>LNG/LPG Process Safety</td>
<td>59</td>
</tr>
<tr>
<td>3092</td>
<td>Maintenance/Mechanical Integrity Optimized through Streamlined RCM</td>
<td>60</td>
</tr>
<tr>
<td>3102</td>
<td>Pressure Relief Systems—Best Practices</td>
<td>61</td>
</tr>
<tr>
<td>3111</td>
<td>Reactive Chemical Hazards Assessment (one-day)</td>
<td>63</td>
</tr>
<tr>
<td>3112</td>
<td>Reactive Chemical Hazards Assessment (two-day)</td>
<td>64</td>
</tr>
<tr>
<td>3121</td>
<td>Reducing Human Error in Process Safety (one-day)</td>
<td>65</td>
</tr>
<tr>
<td>3122</td>
<td>Reducing Human Error in Process Safety (two-day)</td>
<td>66</td>
</tr>
<tr>
<td>3131</td>
<td>Root Cause Incident Investigation (one-day)</td>
<td>67</td>
</tr>
<tr>
<td>3141</td>
<td>Chemical Plant Security</td>
<td>68</td>
</tr>
<tr>
<td>3151</td>
<td>Disposal Systems Analysis—Best Practices</td>
<td>69</td>
</tr>
<tr>
<td>4011</td>
<td>Alarm Management and Fault Detection</td>
<td>70</td>
</tr>
<tr>
<td>4022</td>
<td>Area Classification and Management</td>
<td>71</td>
</tr>
<tr>
<td>4032</td>
<td>Behavioral Safety for the Process Industry—Special Topics</td>
<td>72</td>
</tr>
<tr>
<td>4042</td>
<td>Consequence Modeling—Advanced</td>
<td>73</td>
</tr>
<tr>
<td>4052</td>
<td>Electrostatic Hazards</td>
<td>74</td>
</tr>
<tr>
<td>4061</td>
<td>Engineering Decision Making (one-day)</td>
<td>75</td>
</tr>
<tr>
<td>4062</td>
<td>Engineering Decision Making (two-day)</td>
<td>76</td>
</tr>
<tr>
<td>4072</td>
<td>Gas Explosion Hazards on Offshore Facilities</td>
<td>77</td>
</tr>
<tr>
<td>4082</td>
<td>LNG/LPG Industry Conception &amp; Design</td>
<td>78</td>
</tr>
<tr>
<td>4095</td>
<td>Loss Prevention for the Process Industry—Advanced</td>
<td>79</td>
</tr>
<tr>
<td>4102</td>
<td>Quantitative Risk Assessment Using Fault Tree Analysis</td>
<td>81</td>
</tr>
<tr>
<td>4112</td>
<td>Root Cause Incident Investigation (two-day)</td>
<td>82</td>
</tr>
<tr>
<td>4132</td>
<td>Gas Explosion Hazards for LNG Facilities</td>
<td>83</td>
</tr>
<tr>
<td>4141</td>
<td>Multiple Barriers Concept</td>
<td>84</td>
</tr>
<tr>
<td>4152</td>
<td>Safety Culture</td>
<td>85</td>
</tr>
<tr>
<td>4162</td>
<td>Recent Developments in Process Safety</td>
<td>86</td>
</tr>
<tr>
<td>4172</td>
<td>Dust Explosion Hazards</td>
<td>88</td>
</tr>
<tr>
<td>4182</td>
<td>Blast &amp; Fire Response of Structures in Oil &amp; Gas Facilities and Mitigations</td>
<td>89</td>
</tr>
</tbody>
</table>
Courses Offered via Distance Learning

SENG 422......................................................Fire Protection Engineering........................................ 91
SENG 310......................................................Industrial Hygiene Engineering.................................. 91
SENG 321......................................................Industrial Safety Engineering..................................... 91
CHEN 455/655—SENG 455/655..Process Safety Engineering......................................................... 92
CHEN 460/660—SENG 460/660..Quantitative Risk Analysis in Safety Engineering......................... 92
CHEN 430—SENG 430.................Risk Analysis Safety Engineering..................................................... 92
SENG 312.................................................System Safety Engineering.............................................. 92

Registration........................................................................................................................................ 93

CE Course Legend

XXXX

Course Level: 1—General
2—Specialist (PSM Coordinator, PHA Leader, PSM Auditor)
3—Specialist—Technical
4—Advanced

Course Number

Course Length (Days)
CONTINUING EDUCATION PROGRAM

Expertise

Instructors include leaders in the fields of process safety management, liquefied gas safety, ammonia and fertilizer plant safety, refinery and chemical plant safety engineering, and risk assessment for the process industries.

Customized Courses

The Mary Kay O'Connor Process Safety Center also provides structured training programs aimed at specific company objectives. Any of our short courses can be tailored to the specific needs of the facility if desired. Having the instructor travel to your facility eliminates travel time and costs for the facility employees. This option presents a win-win for you and your employees—no travel, tailored course, and a focused group of colleagues with similar experience and objectives. These courses can accommodate audiences as small as 8 or up to 20, in general. For more information and contract arrangements for a customized course, please contact Valerie Green at 979-845-6884 or by email at val-green@tamu.edu.

Symposia

Each year the Center hosts a Fall Symposium and a Spring Symposium. Both events are eligible for continuing education credit and offer a variety of training and educational opportunities. Please visit our website at: http://psc.tamu.edu/symposia for event information.

Safety Practice Certificate

The Safety Practice Certificate is a program which allows engineers currently in industry to gain a greater knowledge of process safety. This program was created for those industry engineers who want a more in-depth study of process safety in chemical engineering.

The certificate requires 125 PDHs for completion within a three year timeframe. The certificate has 84 PDHs of required courses. The remaining hours may be obtained through courses offered at training facilities in Houston, TX, other distance learning course offerings, and through the Center’s International Annual Symposium in College Station, Texas. There is some flexibility in topic choice with the CE classes, so that applicants can focus their studies in a specific topic area.

The application for this certificate is always open. A worksheet to help you keep track of your credits earned and the application for the program are available at http://psc.tamu.edu/education/safety-practice-certificate. Upon completion of the program requirements, participants will be issued a certificate of completion.
Continuing Education Units (CEUs)/ Professional Development Hours (PDHs)

The CEU is a nationally recognized unit designed to provide a record of an individual’s continuing education achievements. The Engineering Program Office of Continuing Education, in cooperation with the Texas Engineering Experiment Station, has approved the Mary Kay O’Connor Process Safety Center short courses for CEUs.

Per the Texas Board of Professional Engineers: Each license holder shall meet the Continuing Education Program (CEP) requirements for professional development as a condition for license renewal. Every license holder is required to obtain 15 PDH units (1.5 CEUs) during the renewal period year. A minimum of 1 PDH (0.1 CEU) per renewal period must be in the area of professional ethics, roles and responsibilities of professional engineering, or review of the Texas Engineering Practice Act and Board Rules. The complete rule can be found on the Texas Board of Professional Engineers website at RULE § 137.17 Continuing Education Programs.

A CEU certificate will be issued by the Engineering Program Office of Continuing Education upon the successful completion of each course.

PARTICIPANT COMMENTS

“The SIS class tied the code back to practical application.”
Mason D. Martin, ConocoPhillips

“Reviewed the actual step-by-step process for LOPA.”
Stephen Greco, Lubrizol-Deer Park

“I enjoyed the methodology for evaluating chemical hazards.”
Ronnie Hampton, Eastman Chemical

“I enjoyed the identification of terms and conditions of PSM/RMP.”
William (Bill) Worley, El Paso

“Pressure relief design from the equipment perspective.”
Charles Chan, Sempra Utilities

“The instructor had the ability to present the SIS material in an understandable manner with real-world examples.”
Tom Rutherford, Pegasus Intl.

“All PSM points were very helpful and I look forward to taking the advanced class.”
John Jewett, El Paso

“Presentation of Inherent Design was excellent. Delivery and slides were informative, yet not too detailed.”
Brad Cozart, DNV

“Thanks again for a well-presented and informative course. This was the second course I’ve taken at MKOPSC and both have been top notch.”
Jesse L. Roberts, BHP Petroleum
Program Content:
The emphasis of this course is the technical understanding of combustible dust phenomena. It enables attendees to better understand dust hazards, to recognize potential serious events, and to implement effective safeguards. The course will prove helpful to experienced engineers, safety supervisors, and operating managers who are committed to safe workplaces. The course logically builds on:

- Understanding fundamental concepts
- Learning from well-documented dust explosions
- Recognizing factors that influence severity of an event
- Surveying effective risk recognition and hazard mitigation techniques
- Finishing with a comprehensive overview of codes and standards, recognized and generally applied good engineering practices, and with OSHA regulation and their National Emphasis Program

Who Should Attend?
PSM managers, HSE managers, engineers, and operations personnel employed by industries where the presence of hazard zones created by dust is very likely.
Program Content:
The objective of this course is to provide key management individuals within small and medium-sized businesses a comprehensive overview of the requirements for health, safety, and environmental management and resources for managing compliance obligations and risks.

Day 1:
- Issues in enforcement
  - Civil penalties
  - Fines and imprisonment
  - Examples
- Bases of HSE liability
  - Federal, state, and, local regulations
- Liability and exposure
  - Civil and administrative penalties
  - Citizen suits
  - Criminal actions
- Exposures faced by organizations and individuals
  - Corporate
  - Responsibilities of officers
- Elements of responsible corporate leadership
  - Program management
  - Identification and evaluation
  - Prevention and control

Day 2:
- Formulation of a practical, cost-effective program
  - Policy vs. program
  - Auditing
  - Training
- Other components of an integrated program
  - Systems
  - Community and agency relations
  - Planning
- Role of consultants, experts, and attorneys
- Available resources
- Case studies

Who Should Attend?
Company management, financial officers, risk managers, plant managers, and health, safety, and environmental professionals

1.4 CEUs 14 PDHs
Program Content:
Loss Prevention is the application of passive and active systems and management practices to prevent, control, or mitigate fire and explosion effects. Loss prevention is a vital process safety tool in new or existing plants. In the established process plant, original fire, and explosion control concepts based on outdated technology may no longer be a valid defense against losses. Modern process plants require measures that will meet the challenges of modern process plant technology and process equipment with high concentrations of value. The lack of sufficient or properly developed loss prevention measures can also significantly threaten plant personnel and the operation of a plant in a community.

Plant engineers and management, safety manager, and consultants need up-to-date loss prevention knowledge and analysis tools in order to evaluate loss prevention practices and systems. Recommendations from fire marshals, government, or other authorities, from insurance inspectors or industry standards often conflict. Safety measures can become extensive investments, unfortunately with minimal hazard reduction. Attendees using knowledge gained from this course will be able to evaluate proposed loss prevention systems, equipment, and management practices to assure that full value is received for the money expended to achieve plant fire and explosion safety.

This course is based on the basic principle that loss prevention concepts and practices begin with hazard identification. Hazard based prevention, protection and mitigation measures are more effective and cost effective than measures based on more traditional methods. Students will participate in class exercises to compare lessons learned from previous process plant incidents with effective loss prevention measures. Codes and standards will be used as references, and a review of typical industry engineering practices will be used to illustrate loss prevention methods.

Upon completion of this course, participants will be able to identify fire and explosion hazards and assess effective loss prevention measures. Furthermore, participants will gain a working knowledge of loss prevention measures to enable an analysis of conflicting or inadequate proposals for fire and explosion prevention, control, and mitigation.

Day 1:
- Loss Prevention Overview
- Examples
- Hazardous Properties of Hydrocarbons and Processing Materials
- Typical Process Fire and Explosion Hazards
- Industry Experience
- Regulatory and Industry Standards, Codes, and Guides
- Loss Prevention for Projects
Who Should Attend?
Engineers, operations, and maintenance personnel, and first-line supervisors

Day 2:
- Facility Design for Safe Operation
- Site Selection
- Spacing and Layout
- Drainage and Containment
- Electrical Area Classification
- Passive Structural Protection
- Materials of Construction
- Process Control and ESD systems
- Pressure Relief and Depressurizing Systems
- Alarm and Detection Systems
- Fire Suppression Systems
- Surveys, Audits, and Investigations
Program Content:
OSHA’s Process Safety Management standard has identified Management of Change (MOC) as a key element in controlling the potential hazards in a chemical processing facility. MOC policies and procedures are designed to ensure that changes within chemical process plants do not result in operations outside established safety parameters.

The purpose of this course is to explain the concepts and current practice of MOC and to present a methodology designed to develop, implement, and maintain an ongoing MOC program based upon proven engineering management practices and regulatory requirements. In addition to examples of existing MOC policies and lessons learned from related industries, this course will provide sample MOC program outlines and checklists to assist participants in implementing an effective MOC program at their respective facilities.

Upon completion of this course, participants should be able to develop a customized version of the MOC policies and procedures provided herein. Furthermore, participants shall also be well-versed in the practical aspects of maintaining an effective MOC program.

- Concepts
- Definitions
- Principals and examples
- Management of Change practice
- Interface to Process Safety Management program
- Auditing Management of Change
- Risk Management Process requirements
- Screening risk ranking techniques
- Review example procedures

Who Should Attend?
This course is designed for corporate safety officers, chemical process design engineers, technical managers, and plant level chemical manufacturing management.
Program Content:

This course provides an in-depth treatment of the offshore safety engineering topics including hydrodynamics and structural response of floating and fixed offshore structures. The latest analyses and techniques in this area are described together with descriptions of how these are used in the design and assessment of the current generation of offshore production platforms. The wide range of subject areas within ocean engineering has posed problems in making the material available to offshore engineers because most existing books are written within traditional discipline boundaries. Teaching material in ocean engineering is, therefore, distributed between many text books and research papers. This course provides a remedy to the situation by presenting an integrated treatment of the main subject areas that contribute to design, construction, installation, and operation of fixed and floating offshore structures. A significant portion on the course is dedicated to identifying hazard scenarios that could have significant effects on offshore structures. Finally, compliance with API-75 and other standards is given detailed treatment and analysis.

Due to the complexity in exploration, drilling, and production for deep-water plants, almost all types of dangers may occur in these processes. Hazard Identification (HAZID) is the first step of HAZOP analysis. Complete HAZID results will facilitate the LOPA and bow-tie analysis for offshore plants. The risks in offshore are mainly focused in blowout, riser, and pipeline leakage, process system leakage, structural corrosion and failure, fires and explosions, collisions, extreme environmental factors, human and other factors.

- Major Offshore Incidents
  - Ekofisk Alpha Riser Rupture (Nov 1, 1975)
  - Ekofisk Bravo Blowout (April 23, 1977)
  - Ixtoc Blowout (June 3, 1979)
  - West Vanguard Gas Blowout (October 6, 1985)
  - Piper Alpha Explosion (July 6, 1988)
  - Exxon Valdez (March 24, 1989)
  - Petrobras P-36 Explosion (March 15, 2001)
  - Norne Shuttle Tanker Collision (March 5, 2000)
  - Ocean Vanguard Anchor Line Failure (Dec 14, 2004)
  - Transocean Deepwater Horizon (April 20, 2010)

- Underlying causes of incidents
  - Inadequate hazard analysis/ risk assessment
  - Inadequate supervision
  - Lack of/ inadequate operating procedures
  - Inadequacies in permit-to-work
  - Safety Management System (SMS) Failures

- Design issues for Offshore Safety
  - Current and emerging offshore technologies
  - Structural response
  - Hydrostatics of floating bodies
  - Gravity wave theories
  - Fluid loading on offshore structures
  - Dynamic response to waves
Offshore Safety Engineering (Cont.)
2-Day Course

- Tensioned buoyant platforms
- Articulated structures
- Vertical risers
- Catenary mooring systems

**Blowout**
- Blowout preventer (BOP) failure
- Oil nuzzle/hose rapture
- Failure of diverter
- Failure of riser adapter
- Washout of valve

**Riser and pipeline leakage**
- Slurry vessel
- Slurry metric vessel
- Liquid seal of slurry metric vessel
- BOP
- Hose of hydraulic pressure system
- Valve, oil nuzzle, riser pipe
- High hydraulic pressure system

**Leakage (process system)**
- Gas handling process

**Fires or explosions**
- Pool fire (maybe on the platform or in sea, crude oil, or crude product)
- Jet fire (leakage of high pressure equipment, gas, liquid, or aerosol)
- Flash fire
- Vapor explosion

**Structural failure**
- Failure/ fall-off
- Structural fatigue due to long-term service
- Vibration fatigue of pipeline

**Collisions**
- Lift/ down of BOP
- Lift/ down of diverter
- Movement of deck cover

- Collision of oil tanker, supply ship, fishing ship, warship (submarine), and other ships, or supply helicopter with platform

**Corrosion**

**Environmental factors**
- Extreme weather such as strong waves, cyclones
- Earthquakes

**Human factors**
- Fall-off/ slip up/ trip over
- Human error

**Other factors**
- Vibration of slurry pump
- High voltage of electric switches

**Transportation**
- Fire
- Leakage
  - Crude oil/ LNG leak into void
- Structural failure
  - Failure of bulkheads and venting
  - Structural failure to center cargo tank support
  - Collapse/ displacement of center cargo tank
  - Failure of center cargo tank

**Collisions**
- Supply ship, fishing ship, submarine, and other ships
- Helicopter
- Bad weather
- Sinking

**Other factors**
- Vibration of slurry pump
- High voltage of electric switches

**Transportation**
- Fire
- Leakage
  - Crude oil/ LNG leak into void
- Structural failure
  - Failure of bulkheads and venting
  - Structural failure to center cargo tank support
  - Collapse/ displacement of center cargo tank
  - Failure of center cargo tank

**Collisions**
- Supply ship, fishing ship, submarine, and other ships
- Helicopter
- Bad weather
- Sinking
Offshore Safety Engineering (Cont.)
2-Day Course

- API RP 75 Standards—Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities
  - Operations, design requirements, and hazards analysis
  - Requires establishment of safe operating procedures, work practices, Management of Change procedures, and associated training
  - Design, fabrication, installation, testing, inspection, monitoring, and maintenance of equipment meet safe (minimum) standards
  - Recommends periodic auditing of safety programs, emergency response, and incident investigation
- API RP 75 Elements
  - General provisions
  - Safety and environmental information
  - Hazards analysis
  - Management of Change
  - Operating procedures
  - Mechanical integrity
  - Safe work practices
  - Training
  - Pre-startup safety review
  - Emergency response
  - Investigation of incidents
  - Audits
  - Records and documentation

Who Should Attend?
Those involved in process safety management, process hazard analysis, operations, and design of offshore production processes.
Program Content:

Philosophies of risk, data management, segmentation, uncertainty, and other variables impacting pipeline risk are among the topics covered in this course. Pipelines are inherently safer to the public than other modes of freight transportation for natural gas and hazardous liquids (such as oil products) because they are, for the most part, located underground. Nevertheless, the volatile nature of these products means that pipeline accidents can have serious consequences. For example, when a pipeline ruptured and spilled about 250,000 gallons of gasoline into a creek in Bellingham, Washington, in June 1999, three people were killed, eight were injured, several buildings were damaged, and the banks of the creek were destroyed along a 1.5-mile section.

Several federal and state agencies have roles in pipeline safety. The Office of Pipeline Safety (OPS) develops, issues, and enforces pipeline safety regulations for natural gas and hazardous liquid pipelines. These regulations contain minimum safety standards that pipeline companies that transport these products must meet for the design, construction, inspection, testing, operation, and maintenance of pipelines. In general, OPS retains full responsibility for inspecting and enforcing regulations on interstate pipelines but certifies states to perform these functions for intrastate pipelines. Certified states are allowed to impose safety requirements for intrastate pipelines that are stricter than the federal regulations. OPS also uses some states to help inspect interstate pipelines. These states, or “interstate agents,” inspect segments of interstate pipelines within their boundaries. However, OPS handles any enforcement actions identified through inspections conducted by these interstate agents.

- Introduction and background
- Major pipeline incidents
- Underlying causes of pipeline incidents
- Design issues for pipeline safety
- Characteristics of probability of failure algorithms
  - Risk triad
  - Probability of failure assessment steps
  - Model features
  - Orders of magnitude
  - Effective zero
- Probability of failure
  - Failure mechanisms
  - Role of inspection and testing
- Exposure
  - Pipe wall degradation rate
  - Exposure as event per length-time
- Mitigation
  - Mitigation of time-dependent failure mechanisms
  - Mitigation of time-independent failure mechanisms
- Resistance
  - Current pipe strength
  - Estimates of effective pipe wall
  - Procedures to estimate resistance
- Hazard zones
  - Receptors
  - Product hazards
Pipeline Risk Assessment (Cont.)
2-Day Course

- Thermal and overpressure effects
- Thresholds
- Migration from leak sites
- Estimating hazards zones
- Using a fixed hazard zone distance

Who Should Attend?
Those involved in pipeline operations, pipeline risk management, process safety management, process hazard analysis, operations, and design of pipeline processes.

1.4 CEUs 14 PDHs
Program Content:
This course is designed to provide an overview of the process safety program to managers. The content is comprehensive and provides case histories of the implementation of programs at diverse facilities, both big and small and involved in diverse operations. Regulatory requirements covering the process safety management regulations and risk management program regulations are also covered. Emphasis is placed on how process safety programs interact with the overall operations in the plant and what managers can do to minimize risk, but at the same time, keep the plant running productively.

This course is designed to give managers an overall understanding of sufficient details of the process safety programs so that they can efficiently budget for and allocate resources for the program and manage the process safety personnel. Exercises and workshops are used throughout the course to illustrate interpretations of the requirements, and demonstrate ways to develop an effective PSM program.

Who Should Attend?
This course is suitable for managers starting from front-line supervision to executive officers, board of directors, and CEOs. This course provides a high-level organizational perspective of the prevention and compliance requirements for PSM and relates everything to company exposure, risk, and sustainability.
Program Content:
This short course is designed to teach and apply the fundamentals of chemical process safety.

Objectives:
- To provide a basic understanding of Process Safety and the requirements of OSHA PSM Regulation 29 CFR 1910.119 and EPA Risk Management Plan 40 CFR Part 68.
- To understand through case studies how the failure of Process Safety management elements were found to be the root cause of major incidents in the petroleum industry.
- To provide information on how to implement, monitor, and audit a Process Safety Management program.
- To illustrate through exercises the identification of hazards and the ranking of risks.

Day 1:
- Module 1: Introduction
  - Course administration
  - Course participants
  - Objectives of the course
  - History of Process Safety legislation in the USA illustrated through past events
  - What is Process Safety?
  - Process Safety concepts and overview of the PSM elements
- Module 2: Process Safety Management Elements (Description of Each Element)
  - Documentation
  - Employee Participation
  - Accountability and Leadership
  - Process Safety Information
  - Process Hazard Analysis
  - Mechanical Integrity; Case Study: “Humber Refinery—Catastrophic Failure of De-Ethanizer Overhead Pipe”
  - Safe Work Practices (Hot Work); Case Study: “Piper Alpha Disaster”
  - Contractor Management
  - Operating Procedures; Case Study: “Feyzin LPG Disaster”
  - Training and Competence
  - Management of Change; Case Study: “Flixborough Disaster”
  - Pre-Startup Safety Review
  - Emergency Planning and Response; Case Study: “Major Tank Fire”
  - Incident Investigation
  - Process Safety Audit
  - Trade Secrets
Day 2:

- Module 3: Life Cycle Model
  - Holistic Approach
  - Inherent Safety
  - Project Management and Process Safety
  - Getting it “Right”
- Module 4: Hazards and Consequences
  - Types of Failures releasing hazardous materials
  - Video Session documenting vapor cloud, flash fire, explosion (deflagration and detonation), pool fire, BLEVE, Boil-over
  - Toxic Releases
  - Facility Siting
- Module 5: Risk and Risk Analysis Methodologies
  - Hazard and Risk
  - Types of Risk
  - HAZOPS Study
  - Task Risk Assessment—Exercise
- Module 6: Human Factors
  - A Just Safety Culture
  - Ergonomics, fundamental behavior, human error
- Module 7: Texas City Disaster
  - Presentation/Video
  - Exercise: Draw out the holes in the protective barriers using the Swiss Cheese Model
- Module 8: PSM and Other Management Systems
  - Using Synergy from Other Management Systems (ISO 9001, 14001 & OSHA 18001)
  - TQM (Total Quality Management)
  - Gap Analysis
  - Key Process Safety Indicators
  - Audits
- Module 9: Course Summary Followed by an Open Quiz

Who Should Attend?
Anyone involved in improving process safety; including chemical engineers, mechanical engineers, safety and health personnel, industrial hygiene personnel, and operators, and maintenance supervisors.
Program Content:

Day 1:
- Introduction and Background
- Concepts of Risk
- Hazard
- Multiple protection layers safety life cycle
- Qualitative vs. Quantitative analysis
- Risk based decisions
- Competent persons
- Documentation
- Role of standards in risk management
- Process Safety Management Systems
  - Elements of PSM
  - Role of Hazards Identification & Control of Hazards
  - Process Hazard Analysis techniques
  - “What-If” Analysis
  - Checklists
  - Failure mode & effects analysis
  - Fault tree analysis
  - Job safety analysis
  - Event tree/ cause consequence analysis
  - Layer of Protection Analysis (LOPA)
  - Hazard and Operability (HAZOP) study
  - Safety chart methodology
  - Role of hazard identification in Management of Change

Day 2:
- Role of Hazard Identification in Related Process programs
  - ISO 9000 Quality
  - Reliability centered maintenance
  - Safety Instrumented Systems (SIS)
  - Electrical hazards
  - Classification
  - HAZOP study methodology
  - HAZOP team
  - Study nodes
  - Design intent guide words, parameters, and deviations
  - Causes/ consequences of deviations
  - Suggested actions
  - Other applications of HAZOP
  - Implementation of recommended actions

Day 3:
- Layer of Protection Analysis (LOPA)
  - Examples
  - Screening of QRA
  - SIL estimation
- Safe Chart Methodology
  - Unit operations PHA
  - API 14C/ 14J & ISO 10418
  - Workshop and examples
- Quantitative Risk Assessment
  - Overview
- Consequence Analysis
  - Failure case definition
  - Vapor cloud hazard zone calculations
  - Fire hazard calculations
  - BLEVE hazard zone calculations
  - Explosion hazard zone calculations
- Failure Frequency Estimation
  - Probability theory
  - Failure rate data bases
  - Use of fault trees
  - Examples
  - Risk matrix/ risk comparisons
Process Safety Management for Petroleum Production (Cont.)
3-Day Course

- Case study
- Computer tools for hazard identification & risk management
- Summary

Who Should Attend?
The course content is diverse enough for use by anyone involved in improving process safety including chemical engineers, mechanical engineers, safety and health personnel, industrial hygiene personnel, operators, and maintenance supervisors.
Security for the Chemical Process Industry
2-Day Course

Program Content:
This course covers key topics in chemical process security including how to assess vulnerabilities and the adequacy of countermeasures against intentional releases or theft of chemicals. The four main areas of discussion are: strategies, assessment, countermeasures, and regulations.

Day 1:
- Key topics—assessments and regulatory environment.
- Participants will gain an understanding of the available methods for assessing security vulnerability.
- Key methods of assessment will be discussed.
- Learn about the emerging security regulations, government development, and industry activities that relate to security for process facilities including the proposed new Chemical Security Act (S.6), S. 157, and other federal, state, and local regulations.

Day 2:
- Key topics—strategies and countermeasures.
- The course will present strategies that facilities can utilize in managing security of intentional releases.
- Learn how to integrate a process security management program into an existing process safety management program, and to include new critical issues as they relate to the prevention of intentional releases and theft of chemical releases at process facilities.
- Learn about practical and effective countermeasures applications and industry best practices with consideration of both costs and benefits.

Who Should Attend?
Individuals responsible for site security issues including SVA team leaders, team members, security professionals, environmental, health, and safety professionals, supervisors, engineers, and others expected to participate in site security.
Program Content:

The Safety and Environmental Management Program (SEMP) is the process safety and environmental program for the US Gulf of Mexico oil and gas production operations. It was defined by the US Bureau of Ocean Management and Regulatory Enforcement (BOEMRE) to incorporate the API recommended practice 75 and 14J. SEMP has many similar features with the North Sea Safety Case methodology, but does not contain exhaustive quantitative risk assessment studies. It is based upon the highly successful API 14C Safe Chart system issued in the 1970s for top side petroleum production safety system design.

This course also provides an insight into the framework for HAZOP in the context of HSE Management System, which will enrich the effectiveness of the studies and produce a creative and innovative environment. The objectives of the seminar are:

- To provide a framework for offshore safety and environmental management systems.
- To increase familiarity with process and environmental safety methods.
- To describe the role and organizational structure of successful SEMP procedures.
- To provide hands-on experience in the application of SEMP procedures to production systems.
- To appreciate the risk based process and environmental safety methodology.
- To appreciate the consequences of flammable/toxic releases, fire and explosion-dispersion modeling.

Day 1:
- Current Concepts in SEMP
- Regulations and Standards Review
  - API 75/14J
  - Comparison to North Sea Safety Case
- Overview of Elements of SEMP
  - Comparison with Process Safety Management
  - Relation to other API 14 series standards
- Piper Alpha Video
- Safety Information Resources
- Hazards Analysis Techniques
  - Preliminary hazard Analysis HAZID
  - “What-If” Analysis
  - Checklists
  - FMEA
  - API 14C SAFE Chart Methodology

Day 2:
- HAZOP
  - Fault Tree Analysis
  - Layers of Protection Analysis
  - Management of Change
  - Pre-Startup reviews
  - Mechanical Integrity
  - Written procedures
  - Training
  - Safe work practices

Day 3:
- Compliance audits
- Emergency response plans
- Contractor issues
- Incident investigation
- Impact of ISA 84
- SIL calculations
- SIS studies
SEMP for Offshore Oil & Gas Operations and Facilities (Cont.)
3-Day Course

- Consequence Analysis
  - Gas explosion hazards
  - Layout
  - Fire and explosion mitigation systems
  - Fire protection systems
  - Toxic releases
  - Dispersion modeling of toxic releases
- Alarm management
- Vulnerability analysis
- Conformity assessment
- Computer aids
- Strategies for compliance

Who Should Attend?
This course is primarily designed to meet the needs of all offshore oil and gas personnel involved in every level of process operations, production, design, maintenance, as well as, members of the Health, Safety, and Environmental department.
Program Content:

Experience confirms that the long-term prevention of serious safety and security-related incidents requires an effective management process. The techniques presented in this course will assist managers in maintaining the workplace practices and conditions necessary to prevent incidents resulting in serious injuries, property loss, hazardous material releases, business interruption, and other losses that can be controlled through effective safety and security practices.

This course includes a review and application of the proven management methods described in Mr. Burns’ book, *Serious Incident Prevention*, 1999, Gulf Professional Publishing, as well as the *Site Security Guidelines for the U.S. Chemical Industry*, and an overview of the proposed *Chemical Security Act of 2001*. The course utilizes group exercises and applications of techniques to the process industry to enhance the learning experience.

**Day 1:**
- Serious incident trends for safety and security
- Overcoming barriers for improvement
- Effective management leadership for safety and security
- Leveraging the power of employee involvement for improved safety and security
- Identifying and understanding safety and security risks
- Identifying and prioritizing the work critical to preventing safety and security incidents

**Day 2:**
- Review and Implementation of Site Security Guidelines for U.S. Chemical Industry and overview of proposed *Chemical Security Act of 2001*
- Establishing measures for upstream performance indicators for safety and security
- Proactive corrective action and identification of root causes
- Workshop demonstrating implementation of techniques for safety and security applications in the process industry

**Who Should Attend?**

This course is designed for personnel having responsibilities for the prevention of incidents that can be controlled through the application of effective safety and/or security practices. Personnel who should attend include safety professionals, security managers, line managers, and other personnel interested in achieving and sustaining safer and more secure workplaces.
Program Content:

The student will be provided ideas and guidance for management representatives and team members in charge of establishing, expanding the scope, integrating, or just improving the performance of their organization’s SHE management systems. The course will not only familiarize participants with the basic requirements of the current management system and technical specifications, but will also address the problem areas of implementation and maintenance, including how to achieve and maintain the active involvement of all employees, including top management.

Examples of discussed topics:

- The basic SHE Management System
- How to identify, assess, and prioritize SHE aspects and hazards
- How to communicate regulatory requirements to operate units more effectively
- How to overcome the most common system implementation and maintenance hurdles
- And several others

Who Should Attend?

SHE managers, SHE Coordinators, safety and health personnel, and auditors.

Note: This class is also available as a two-day class.
Program Content:

The student will be provided ideas and guidance for management representatives and team members in charge of establishing, expanding the scope, integrating, or just improving the performance of their organization’s SHE management systems. The course will not only familiarize participants with the basic requirements of the current management system and technical specifications, but will also address the problem areas of implementation and maintenance, including how to achieve and maintain the active involvement of all employees, including top management.

Examples of discussed topics:

- The basic SHE Management System
- How to identify, assess, and prioritize SHE aspects and hazards
- How to communicate regulatory requirements to operate units more effectively
- How to overcome the most common system implementation and maintenance hurdles
- And several others

Who Should Attend?

SHE managers, SHE Coordinators, safety and health personnel, and auditors.

*Note: This class is also available as a one-day class.*
What Went Wrong? Learning from Chemical Plant Incidents
1-Day Course

Program Content:

Awareness of chemical and petroleum process safety fundamentals is vital to the success of all that work in chemical plants and refineries. Get a real life look at case histories of process accidents in the chemical industry. Heighten your awareness, understanding, and appreciation of the fundamentals which create chemical plant accidents. Participate in an interactive review and exchange covering numerous actual process incidents reinforced by hundreds of vivid images of plant sites in peril, fires, or damaged equipment. These exercises examine the management system needs for safe operations.

Enjoy a practical, fast-paced, interactive exchange on process safety details between you, other attendees, and the presenter.

- Improve safety awareness within facilities when employees have failed to notice the high potential for safety related incidents.
- Increase awareness level of proper Management of Change policies.
- Understand the basics of fires and explosions and understand “Tales Tanks Tell” about process safety (Tanks are often the victims of chemical process and reveal mistakes), as illustrated through case histories.
- Understand the fundamentals of process safety to protect people, ensure the integrity of the equipment, and preserve the viability of the organization.
- Gain an appreciation of a “situation response” teaching technique that the attendee can use in their own companies to spread knowledge and understand some of the basics of human error.
- Learn of resources to use at your workplace while witnessing fires, explosions, or damaged equipment, and determine the approach to shape your process safety programs.

Course Outline:

- Introductions & expectations
- Risk & Perceptions of Risk—Risks are not always as they appear. This introductory module examines risks of industry and ordinary life factors.
- Accidental Fires & Explosions—This module looks at the fundamentals of fires and explosions. It also reviews cases of incomplete hot work permits and process maintenance flaws which lead to massive leaks.
- Plant Modifications: Troubles & Treatment—This portion of the program looks at how many small, seemingly helpful, well-intentioned changes can lead to unintended troublesome consequences. This reinforces the need for effective Management of Change programs.
What Went Wrong? Learning from Chemical Plant Incidents (Cont.)
1-Day Course

- Incident Investigations—How Far Should We Go? This is a classic look at accident investigations developed by Dr. Trevor A. Kletz, in which five different investigators reviewed the same case and came up with five drastically different causes.
- Pump Explosions—Dangers of dead heading pumps.
- Tales Tanks Tell—A look at a wide array of process safety incidents in which various elements of process safety were not considered and tanks suffered.
- Human Error—Why some people act as they do within chemical plants.
- Layers of Protection—A look at many of the within-the-fence training, hardware, and procedures with enhanced process safety
- Wrap Up, Evaluations, and Quiz


Who Should Attend?
Chemical Process Safety must be second nature to all who design, operate, and maintain refineries and chemical plants. The material is best suited to operations supervisors, lead operators of chemical manufacturing units or petroleum refining units, maintenance foremen, plant related managers, process engineers, design engineers, plant safety engineers, property insurance professionals, and other professionals interested in Chemical Process Safety awareness.

*Note: This class is also available as a two-day class.*
Program Content:

Awareness of chemical and petroleum process safety fundamentals is vital to the success of all that work in chemical plants and refineries. Get a real life look at case histories of process accidents in the chemical industry. Heighten your awareness, understanding, and appreciation of the fundamentals which create chemical plant accidents. Participate in an interactive review and exchange covering numerous actual process incidents reinforced by hundreds of vivid images of plant sites in peril, fires, or damaged equipment. These exercises examine the management system needs for safe operations.

Enjoy a practical, fast-paced, interactive exchange on process safety details between you, other attendees, and the presenter.

- Improve safety awareness within facilities when employees have failed to notice the high potential for safety related incidents.
- Increase awareness level of proper Management of Change policies.
- Understand the basics of fires and explosions and understand “Tales Tanks Tell” about process safety (Tanks are often the victims of chemical process and reveal mistakes), as illustrated through case histories.
- Understand the fundamentals of process safety to protect people, ensure the integrity of the equipment, and preserve the viability of the organization.
- Gain an appreciation of a “situation response” teaching technique that the attendee can use in their own companies to spread knowledge and understand some of the basics of human error.
- Learn of resources to use at your workplace while witnessing fires, explosions, or damaged equipment, and determine the approach to shape your process safety programs.

Course Outline:

- Introductions & expectations
- Risk & Perceptions of Risk—Risks are not always as they appear. This introductory module examines risks of industry and ordinary life factors.
- Accidental Fires & Explosions—This module looks at the fundamentals of fires and explosions. It also reviews cases of incomplete hot work permits and process maintenance flaws which lead to massive leaks.
- Plant Modifications: Troubles & Treatment—This portion of the program looks at how many small, seemingly helpful, well-intentioned changes can lead to unintended troublesome consequences. This reinforces the need for effective Management of Change programs.
What Went Wrong? Learning from Chemical Plant Incidents (Cont.)

2-Day Course

- Incident Investigations—How Far Should We Go? This is a classic look at accident investigations developed by Dr. Trevor A. Kletz, in which five different investigators reviewed the same case and came up with five drastically different causes.
- Pump Explosions—Dangers of dead heading pumps.
- Tales Tanks Tell—A look at a wide array of process safety incidents in which various elements of process safety were not considered and tanks suffered.
- Human Error—Why some people act as they do within chemical plants.
- Layers of Protection—A look at many of the within-the-fence training, hardware, and procedures with enhanced process safety
- Wrap Up, Evaluations, and Quiz


Who Should Attend?
Chemical Process Safety must be second nature to all who design, operate, and maintain refineries and chemical plants. The material is best suited to operations supervisors, lead operators of chemical manufacturing units or petroleum refining units, maintenance foremen, plant related managers, process engineers, design engineers, plant safety engineers, property insurance professionals, and other professionals interested in Chemical Process Safety awareness.

*Note: This class is also available as a one-day class.*
Program Content:

The HAZID review is a traditional risk assessment methodology where guidewords are used by the HAZID team to populate the worksheets. The methodology involves identifying all known risks and then assessing the cause, consequences, and safeguards in place for each risk identified. In general, the review team considers the controls to be inadequate. A recommendation is made for each identified scenario that leads to an unacceptable risk. The resolution of the recommendation is then assigned to an appropriate department or individual.

A Hazard Identification Study or HAZID is a tool for hazard analysis, used early in a project as soon as process flow diagrams, draft heat and mass balances, and plot layouts are available. Exiting site infrastructure, weather, and geotechnical data may also be required, these being a source of external hazards.

The method is a design-enabling tool, acting to help analyze the hazards before a project moves forward. The structured brainstorming technique typically involves designer and client personnel engineering disciplines, project management, commissioning and operations.
Program Content:
The American Chemistry Council (ACC) and the Synthetic Organic Chemical Manufacturers Association (SOCMA) are mandating that all member companies adopt and be certified by third parties for conformance to one of two health, safety, security, and environmental (HSSE) management system models, as part of a totally revamped Responsible Care® program. Although the technical specifications for these two models, designated RCMS® and RC14001, have some differences in their structure and detail, they share a basic plan-do-check-act framework that drives continual improvement of HSSE performance. Key to this continual improvement process is an internal management system auditing program.

This intensive workshop is essential for internal EMS auditors and those establishing audit programs for Responsible Care Management Systems®. The course will equip participants with the necessary knowledge and skills to audit conformance to the requirements of both the RCMS® and the RC14001 specifications. The presenter’s personal experience has proven that successful and effective internal auditors may be drawn from any level and function within an organization, and need not necessarily have backgrounds in HSSE or quality management.

Who Should Attend?
Process safety managers, SHE managers, and auditors.
Program Content:
Recent major incidents involving vapor clouds, explosions, and fireballs have intensified industry and government efforts to understand and manage these risks. The increased use of risk-based decision analysis requires consequence modeling of such accident scenarios.

The objective of this course is to explain the basic physical principals of consequence modeling as it relates to the petrochemical industry. The course presents practical state-of-the-art methods for evaluating the consequences of flammable and toxic vapor cloud dispersion, vapor cloud explosions, confined explosions, pool fires, flare and torch fires, and Boiling Liquid Expanding Vapor Explosions (BLEVEs). Theoretical research and experimental data will be presented that support the choice of models for specific applications. Examples of actual accidents illustrate and validate the models used.

This course is intended for engineers and safety professionals who are required to understand and quantify the effects of accidental releases that result in toxic and flammable vapor clouds, explosions, and BLEVEs with fireballs.

- Introduction to modeling procedures
- Basic concepts used in consequence analysis
- Examples of model applications to accidental releases
- Fire radiation models
  - Pool fires
  - Flares
  - Torch fires
  - BLEVEs and fireballs
- Explosions
  - TNT models
  - TNO multi-energy
  - Baker-Strehlow
- Vapor dispersion
  - Source models
  - Aerosols
  - Pool vaporization
  - Dense gas dispersion
  - Momentum jet dispersion

Who Should Attend?
Safety practitioners, process engineers, other technical professionals responsible for compliance with 40 CFR Part 68.

1.4 CEUs 14 PDHs
HAZOP Expert System
2-Day Course

Program Content:
HAZOP (Hazard and Operability Study) has been recognized as the most comprehensive methodology to develop Process Hazard Analysis under Process Safety Management (PSM) rule. However, the brainstorming stimulated process has the following shortcomings: time consuming, laborious, expensive, and inconsistent. The quality of HAZOP depends on the knowledge and experience of the HAZOP team. Many studies of incidents have shown the inadequacy of PHA as one of the root causes. To promote the efficiency and integrity of HAZOP, various expert systems have been developed. Among different expert systems, model based and/or rule-based system can only address general process analysis, while case-based systems can be applied for process specific or plant specific study.

The objective of this course is to introduce the development and benefit of the usage of case-based HAZOP expert system. The course presents the hierarchical structure of the embedded database and expert system, the case-based reasoning module, and the characteristics of a typical HAZOP expert system. Several case studies illustrate the advantages of the expert system. Finally the course provides the chance to practice a typical HAZOP expert system-PSMSuite in a workshop.

This course is intended for engineers and safety professionals who are required to attend HAZOP analysis as team members or facilitators or who are interested in artificial intelligence technique development of HAZOP analysis.

- Introduction to HAZOP
  - Regulations
  - Procedures and team requirements
  - Advantages and pitfalls
- Development of HAZOP expert system
  - Model-based and/or rule-based system
  - Advantages of case-based system
- Case-based HAZOP expert system
  - Case-based reasoning (CBR)
  - Ontology
  - Case-based module
  - CBR engine module
  - Knowledge maintenance module
  - Characteristics of a typical HAZOP expert system
  - Case studies to illustrate the functions
  - Workshop and practice

Who Should Attend?
Safety practitioners, process engineers, PHA facilitators, other technical professionals responsible for compliance with 29 CFR Part 1910.119.
Layer of Protection Analysis (LOPA)  
2-Day Course

Program Content:

Layers of Protection Analysis (LOPA) is a popular risk analysis technique. It is conducted after a process hazards analysis has identified hazardous events needing further analysis to better understand the functional and risk reduction requirements for the safeguards. This course discusses the quantitative assessment of initiating event frequencies and the robustness of safeguards.

The course stresses understanding of event propagation, the attributes required for safeguards to be qualified as Independent Protection Layers (IPL), and the proper determination of hazardous event frequencies. Evaluating enabling conditions and the appropriate use of frequency modifiers in PHA and LOPA are discussed, as well as the interrelationship of risk criteria and analysis boundaries. The course addresses how to document risk gaps in LOPA recommendations, including using LOPA to assign the target Safety Integrity Level (SIL) to identified Safety Instrumented Systems (SIS). Workshop examples are used to illustrate the methodology and emphasize key learning points.

- Risk management
- Risk criteria
- Independent Protection Layers (IPL)
- Core attributes
- LOPA methodology
- IPLs and side effects

Day 1:

- Risk management
  - Process risk measurements
  - PHA workshop
- Risk criteria
  - Hazardous and harmful events
  - Enabling conditions and conditional modifiers
  - LOPA criteria
  - Frequency workshop
- Independent Protection Layers (IPL)
  - Types
  - Assessing independence
  - Independence workshop
- Core attributes
  - Core attributes workshop
Layer of Protection Analysis (LOPA) (Cont.)
2-Day Course

Day 2:
- LOPA methodology
  - Initiating cause frequency
  - IPL risk reduction
  - Independence of control and instrumented safety functions
- LOPA IPL workshop
- IPLs and side effects
  - Understanding secondary Consequences
- Multiple LOPA workshop examples

Who Should Attend?
Process safety managers, process safety specialists, process engineers, operations personnel, instrumentation and electrical personnel, LOPA facilitation trainees, LOPA facilitators, and PHA facilitators.
Process Hazard Analysis Leadership Training  
2-Day Course

Program Content:
This course is intended to prepare PHA team members for team leadership. It introduces techniques commonly utilized in the petrochemical, chemical, and oil and gas industries. It also includes hands-on example problems from industry.

Many engineers or operating company professionals have attended PHAs, but have not been prepared for the unique requirements of team leadership. This course, while providing an introduction to PHA methodologies, is intended to augment the skill sets of those persons. Each class offering is adjusted to meet the specific needs of the current class members, with class interaction encouraged.

Following introductions of class members, the course starts with a simple presentation on hazard and operability studies (HAZOP 101), and a hands-on example problem. Next, the team discusses the evolution of PSM in the United States so that team leaders understand how PSM came about.

Regulatory requirements for PHAs are then discussed, including Process Safety Management (PSM) programs, Risk Management Programs (RMP), and Safety and Environmental Management Systems (SEMS). Discussion includes when studies are required, and assists the PHA leader in identifying and managing compliance issues.

Along with discussion of the PHA methodologies, attendees discuss how to prepare for a PHA, and then how to manage the team during the project implementation. Preparation of reports is another topic, presented with visual examples. Additionally, checklists of general safety issues, facility siting issues, and human factor issues are included in the class notes.

Day 1:
- Introductions
- HAZOP 101 with workshop
- Evolution of PSM
- Regulatory requirements for PHAs
- Preparation for PHAs
- Leadership skills for managing teams
- HAZOPs—in detail
- HAZOP workshop

Day 2:
- What-If? And What-If? / checklist
- What-If? workshop
- FMEA and fault tree analysis
- PHA reports and documentation
- Facility siting, human factors
- LOPAs in PHAs
- PHA software
- PHAs for batch processes
- PHAs for process modifications
- Final workshop

Who Should Attend?
Process Hazard Analysis participants

1.4 CEUs 14 PDHs
Program Content:

The objective of this course is to provide the participant with the tools necessary to establish a comprehensive Health, Safety, and Environmental Auditing program. Emphasis will be placed on PSM and RMP compliance audits with discussion on applicability to occupational safety and health. Discussions include how to design a management system auditing program, how to conduct a field audit, and how to report the findings and recommendations to management.

Day 1:
- Introduction to management system
- Safety inspections vs. system audits
- Auditing a management system
- Creating effective tools
- Pre-audit activities
- Establishing the scope, team members, and scheduling
- Onsite activities
- Opening conference
- Note-taking, walk around, interviews, and sampling

Day 2:
- Post-audit activities
- Closing conference
- Presenting your findings and recommendations
- Report writing
- Addressing the recommendations
- PSM compliance auditing
- Regulatory refresher
- Key program elements
- Testing for compliance
- RMP compliance auditing
- Regulatory additions to PSM

Who Should Attend?
Process Safety Management coordinators, Risk Management Planning coordinators, and new Health, Safety, and Environment auditors
Program Content:
This course reviews the various good engineering practices that apply to Safety Instrumented Systems (SIS) implemented in process industry facilities. It presents the requirements of IEC 61511 using a lifecycle framework that is supplemented with several industrial guidance documents. It explains how risk analysis techniques, such as Layer of Protection Analysis (LOPA), are used to identify the need for administrative and engineered safeguards. IEC 61511 establishes requirements for designing and managing SISs to achieve specified Safety Integrity Levels (SIL), which are related to order of magnitude ranges of risk reduction. When LOPA determines that an SIS is required, the required risk reduction becomes the target SIL for the SIS.

The course is designed to provide the student with an understanding of the required safety management system, how to perform LOPA to identify the need for an SIS and to assign the SIL, how to design the SIS to meet the specified SIL, how to verify that the SIL can be achieved, and how to develop an operating plan to maintain the SIL throughout the SIS life.

- SIS standards overview
- Planning
- Process risk and protection layers
- Establishing risk evaluation criteria
- Layer of Protection Analysis (LOPA)
- Selection of devices
- Data estimation
- Design decisions
- Verification example
- Operating basis

Day 1: Getting Started

Module 1—SIS Standards Overview
This course begins with a brief introduction to the various good engineering practices that apply to Safety Instrumented Systems (SISs) implemented in process industry facilities. Special focus is given to international standards, such as IEC 61511 and 61508, and recognized guidance documents, such as the CCPS Guidelines books and several ISA technical reports.

Module 2—Planning
An overview of IEC 61511 is presented followed by detailed requirements for the safety management system contained in clauses 5 through 7. Key elements are competence, independent review, verification, functional assessment, management of change, and auditing.
Module 3—Process Risk and Protection Layers
Process risk derives from process miss-operation and is an inherent part of process design. This inherent risk must be reduced below internationally accepted risk criteria using Independent Protection Layers (IPLs) that are designed and managed to meet seven (7) core attributes.

Module 4—Establishing Risk Evaluation Criteria
The risk assessment phase is addressed in IEC 61511 Clauses 8 and 9. The initiating events for process hazards are identified, and the frequency and consequence severity of each potential event is estimated. Depending on the type of risk analysis, various conditional modifiers may also be considered when assessing the risk. Once the risk is understood, a risk reduction strategy can be developed.

Day 2: Risk Analysis to Design

Module 5—Layer of Protection Analysis
Layer of protection analysis (LOPA) is covered in the CCPS book, Layer of Protection Analysis: Simplified Process Risk Assessment. LOPA identifies the initiating events and their frequency, the consequences and their severity, the required risk reduction, and the protective functions implemented in each protection layer to achieve the required risk reduction.

Module 6—Safety Requirements Specification (SRS) Part 1
The SRS in IEC 61511 Clause 10 is a collection of information that specifies the SIS design basis required to ensure process safety during all operating modes. The SRS defines the functionality, integrity, reliability, operability, and maintainability requirements based on operational goals, intended operating modes and process safety time limitations.

Module 7—Safety Requirements Specification Part 2
IEC 61511 Clause 11 provides many specific design requirements including the need for fault tolerance and separation of the SIS from the BPCS.

Module 8—Selection of Devices
SIS device selection is addressed in IEC 61511 Clause 11.5. ISA TR84.00.04 guidance is presented related to field devices and logic solvers. Emphasis is placed on demonstrating that the device is user-approved for safety based on a review of manufacturer information and actual field experience.
Day 3: Verification and Operating Basis

Module 9—Data Estimation
IEC 61511 Clause 11.9 requires verification of the SIS performance through calculation of the probability of failure on demand (PFD) and the spurious trip rate of the SIS as specified and maintained. Various types of data estimates are discussed with an emphasis on collecting internal and industrial data.

Module 10—Design Decisions
The voting architecture, diagnostic coverage, proof test interval, and common cause failure potential affects the achievable PFD, and the spurious trip rate. The impact of each design decision is discussed and typical examples are presented.

Module 11—Example Verification
An example of Safety Instrumented Functions (SIF) will be assessed to illustrate how choices in field device architecture, test interval, and logic solver technology affect the achievable PFD and spurious trip rate.

Module 12—Operating Basis
There are many day-to-day operational and maintenance activities that must take place for the SIS to sustain its expected performance throughout its installed life. Operation and maintenance procedures must be developed and verified prior to the introduction of hazards into the process unit. These procedures support the detection and response to faults and process alarms, the initiation of manual shutdown, reset after shutdown, and proof tests.

Who Should Attend?
Control systems, instrument, electrical, and process safety specialists, PSM managers, and PSM compliance auditors.
Program Content:

This course covers the performance verification of Safety Instrumented Functions (SIF), including calculation of the Probability of Failure on Demand (PFD) and Spurious Trip Rate (STR). These calculations must take into account the device failure rates, system architecture, subsystem voting configuration, specified diagnostics and testing, and repair times. The PFD calculation must also take into account the susceptibility of the SIF to common mode and common cause failure.

IEC 61511 requires that the PFD be verified by calculation to prove that each SIF meets its target Safety Integrity Level (SIL). This course provides students with an understanding of the fundamentals needed to address this requirement in their workplace. It familiarizes students with Failure Modes and Effects Analysis (FMEA), the identification of safe, dangerous, detected, and undetected device failures, the selection of failure rate data, understanding key design parameters, and applying the calculation methodology. The two approaches for approving a device for use in an SIS - certification and prior use - are also explained.

The course presents a series of examples as workshops to illustrate the important concepts and assumptions implicit in the calculations. **The student must bring a scientific calculator and notepad to the course.**

- Overview of the requirements of SIS standards
- Failure analysis fundamentals
- Failure Modes and Effects Analysis (FMEA)
- Introduction to the math for probability of failure on demand and spurious trip rate
- Key elements affecting performance
- Workshops -- problems worked by students. Various cases will be modeled showing how changes to design and maintenance strategy affect results.

Day 1:

- Overview of SIS standards
- Failure fundamentals—Failure Modes and Effects Analysis (FMEA)
- Introduction to the math for probability of failure on demand and spurious trip rate
- Key Elements
  - Integrity—Where do you get data from? What does it mean?
  - Voting/Fault Tolerance—why do you need redundancy? How does it help?
  - Test Interval—How does the test interval affect the integrity?
  - Diagnostic Coverage—What effect does diagnostics have?
  - Common Cause—How is this modeled?
Safety Integrity Level (SIL) Verification
2-Day Course

- Periodic workshops throughout the day
  - How to read manufacturer certification reports
  - How to model SIF based on LOPA recommendations
  - Understanding mean time to failure and useful life
  - Partial stroke testing and proof test coverage

Day 2:
- Example System
  - Impact of diagnostics and need for compensation measures
  - Calculation demonstration showing the impact of redundancy
- Workshops—problems worked by students. Various cases will be modeled showing how changes to design and maintenance strategy affect results.

Who Should Attend?
Control systems engineers, instrument engineers, and process safety specialists.
Program Content:

The objective of this course is for the participant to understand root cause incident investigation techniques for chemical process incidents.

This course is intended for technical personnel who will lead or participate in root cause investigations of chemical process incidents. It presents an overview of key concepts for root cause investigation through a series of class exercises, video, and discussions. This course is based on investigation guidelines published by the Center for Chemical Process Safety (CCPS), industry practices for root cause analysis, and portions of the National Fire Protection Association 921 Guide for Fire and Explosion Investigations, 2001 edition.

Day 1: Investigation models; Definitions & key concepts; Class exercises in critical thinking/logic; Examples of deductive investigative approaches; The Incident Investigation Management System; Root Cause Tools; Class exercise in time-line application; Class exercise in logic diagram application.

Day 2: Evidence-gathering, identifying, preserving and analyzing; Witness interview workshop; Developing root cause recommendations; Effective incident reporting; Case Study-root cause investigation of a chemical process event; Investigation team activities; Root causes of classic process incidents (Piper Alpha, Three Mile Island, Flixborough, Bhopal and others); Practical applications of root cause concepts.
Process Safety Auditing
2-Day Course

Program Content Coming Soon!

1.4 CEUs
14 PDHs
Safeguarding Memoranda & Process Safeguarding Flow Scheme (MOC)
1-Day Course

Program Content Coming Soon!

0.7 CEUs
7 PDHs
Coaching to Meet the Press and Other Hostile Audiences
2-Day Course

Program Content:
Someday, you may be called upon to act as a spokesperson for your organization during a crisis. Whether it is in your official job description or not, if you have technical knowledge of your company’s operations or expertise in the areas of environmental, health and, safety, the media and the public may want to hear from you when something has gone wrong, or fear that it will.

Media-savvy people cannot easily be given an effective “crash course” to prepare them to answer the technical questions that may come after an accidental spill, release, injury on site, etc. However, those of you with the required technical knowledge can be provided with the skills to help you communicate important and major messages to the media and the public so you can assist the official company spokesperson in protecting your corporate image. This course will cover:

- Introduction
  - Participants and instructor share experiences
  - What is a crisis?
  - Risk perception
  - Journalists’ priorities
  - What could happen in your organization?
  - The value of a crisis plan
- Organizing to handle a crisis effectively
  - Choosing a spokesperson
  - Putting your crisis management team to work
  - Know your audiences
- Dealing with hostile people/media
  - The incredible importance of listening
  - The “10 Cs” of good crisis communications
  - Two “Cs” to avoid
- Avoid “no comment” whenever possible
- Going “above and beyond”
- Presenting your message
  - Strive for “one-day, local-only” coverage
  - Questions you are apt to be asked
  - The all-important issue of trust
  - Developing and “bridging” to your “must air” messages
  - Making your messages memorable (sound bites)
  - Put it all together—media worksheet
  - The elements of body language
  - Offering written materials
  - Combating trick questioner techniques
  - Role-plays of realistic scenarios

Who Should Attend?
Plant managers, public relations personnel, and anyone having to do with the public during emergencies and incidents.

<table>
<thead>
<tr>
<th>CEUs</th>
<th>PDHs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>14</td>
</tr>
</tbody>
</table>
Engineering Design Practices for Safer Process Plants
2-Day Course

Program Content:
Attend an interactive, dynamic, comprehensive course on process safety and learn the application of safety principles to Engineering Design and Operations from experienced practitioners. We will study the application of risk based principles in the design of process plants and the impact on safety. We will look at some practical successful applications of incorporating inherent design principles into the initial plant design. We will review the issues of safety in plant layout, and get an understanding of the characteristics of process equipment for safe operations.

Also, we will cover the aspects of piping design that affect safe operation, learn the basics of Safety Instrumented Systems, review code and regulations necessary for the implementation of flare systems, and the application of safety relief valves. We will study the basics of electrostatic, and other ignition sources, as well as electrical systems hazards, and learn the basics of explosion protection systems and flame arrester technology.

Attendees should leave the course with greater confidence, appreciation of safety issues, and alternate solutions to many safety problems, i.e., how to avoid fires, explosions, toxic emissions, etc.

Who Should Attend?
Chemical, other engineers, as well as chemists.
Program Content:

Facility Siting (layout and spacing) is an important consideration for the safe operation of manufacturing facilities. The Process Safety Management regulation (29 CFR 1910.119) specifically requires that facility siting issues be addressed when conducting Process Hazard Analyses (PHA). However, compliance with the OSHA standard is only one of the benefits to be gained by taking a closer look at equipment and building layout. Existing facilities can use a facility siting analysis to evaluate existing conditions, identify potential safety concerns, and evaluate mitigation plans. The facility siting analysis can also be used to assist in the determination of the optimal location for placing new buildings or process components. This course presents an overview of industry standards related to equipment spacing and layout, various evaluation techniques, common siting-related safety concerns at existing facilities, and examples of how to address layout problems and choose locations for new equipment. Issues covered in a facility siting analysis include:

- Identifying hazard scenarios that could have significant effects on occupied buildings
- Identifying vulnerable locations of control rooms, and other buildings that may be occupied by people
- Spacing of process units
- Spacing between equipment and employees in occupied buildings, and equipment and potential ignition sources
- Domino effects, i.e.: the potential for an incident to propagate from one process area to another separate area
- Analysis of the ability for an occupied building to provide sheltering-in-place
- Emergency response issues such as availability of emergency equipment, and location of fire suppression systems

Course Outline:

- Regulatory background
  - OSHA’s Process safety Management regulations
  - EPA’s Risk Management rule
  - Citations
- Industry standards
  - API—752
    - Accident scenario development
    - Explosion, toxic, and fire hazard prediction
    - Risk and consequence evaluation
  - Remedial action development
  - Hazard management near portable buildings
  - Facility siting study updates
  - Occupancy, explosion consequence, and risk screening analysis
  - Structural assessments of existing buildings for blast loads and modeling
  - Facility siting guidelines and corporate risk criteria development
• API—753
  • Providing guidance on the safe placement of portable buildings
  • Minimizing the presence of personnel in refinery process areas
  • Minimizing the use of occupied portable buildings in refinery process areas
  • Designing, constructing, and installing these buildings or trailers for the protection of the occupants

• API—756
  • Tent and fabric structure Evaluation processes
    • Hazards of concern and unique considerations for tents and fabric buildings
    • Determination of tents and fabric structures requiring siting evaluation
  • Tent and fabric structure siting evaluation for explosion
    • Methods for locating tents and fabric structures for explosion hazards
    • Simplified method
    • Detailed analysis
    • Overpressure damage levels
    • Blast resistance requirements
    • Additional risk reduction practices
  • Tent and fabric structure siting evaluation for fire
  • Tent and fabric structure evaluation for toxics

• Uses of siting evaluations
  • Site survey and selection
    • Information required to select a site
    • Transportation issues
    • Utilities
    • Electrical and communications systems
    • Environmental controls
    • Fire, safety, and security
    • Site features
  • During process hazard analysis
  • Building location studies
  • Siting of new equipment

• Siting methodologies
  • Evaluating buildings
  • Evaluating process areas
  • Developing release scenarios
  • Evaluating hazards

• Insurance company guidelines
  • Factory mutual
  • Industrial risk insurers
  • Examples

• Fire and Explosion Index
  • Examples

• Chemical Exposure Index
  • Examples

• Computer models
  • Explosion models
  • Dispersion models
  • Examples

• Prioritizing hazards
  • Quantitative
  • Semi-quantitative
  • Qualitative

• Corrective actions

• CCPS Documents
Who Should Attend?

Those involved in process safety management, process hazard analysis, plant operations, process design, have the responsibility for developing siting and layout, and developing compliance programs for regulatory requirements.
Program Content:
Recent major incidents involving vapor clouds, explosions, and fireballs have intensified industry and government efforts to understand and manage these risks. The increased use of risk-based decision analysis requires consequence modeling of such accident scenarios.

The objective of this course is to explain the basic physical principals of consequence modeling as it relates to the petrochemical industry. The course presents practical state-of-the-art method for evaluating the consequences of flammable and toxic vapor cloud dispersion, vapor cloud explosions, confined explosions, pool fires, flare and torch fires, and Boiling Liquid Expanding Vapor Explosions (BLEVEs). Theoretical research and experimental data will be presented that support the choice of models for specific applications.

Course Outline:
- 1990 Clean Air Act Amendments
  - OSHA’s PSM regulation
  - Section 112(r)
  - EPA’s focus group on chemical accidental release prevention programs
  - Rulemaking status and schedule
- EPA’s Risk Management Program
  - Overview of EPA’s final list
  - Overview of the EPA rule and board requirements
  - Hazard assessment
  - Regulatory requirements
  - Offsite consequence analysis
  - 5 year accident history
  - Number of scenarios
  - Toxics of calculations
  - Flammable calculations
  - Explosives calculations
  - Use of EPS’s numeric tables versus computer modeling
- Risk Management Plan (RMP)
  - Contents of an RMP
  - Submittal of RMPs
  - Auditing procedures and enforcement of EPA orders
  - Communicating Risk Information to the Public
- Organizational issues
  - LEPC/public relations
  - Education of the LEPC and the public
  - Community awareness
- Hazard assessment
  - Failure case definition
  - Characterizing component failure
  - Protocol for developing worst-case scenarios
  - Protocol for developing more probable scenarios
  - Defining the Release conditions
  - Properties of the Released Fluid
  - Summary of Required Information
  - Vapor cloud hazard zone calculations
  - Vapor generation
  - Atmospheric movement
  - Vapor cloud modeling
  - Gaussian dispersion models
  - Heavy gas cloud modeling
  - Modeling of high velocity releases
  - Vapor containment
  - Fire hazard calculations
  - Radiant heat flux from pool fires
  - Geometric view factor
Hazard Assessment (Cont.)
2-Day Course

- Damage and injury criteria for radiant heating
- BLEVE hazard zone calculations
- Cause of BLEVEs
- BLEVE hazards
- Explosion hazard zone calculations
- Cube root scaling

Who Should Attend?
Those involved in the risk management program, and who want to develop an understanding necessary for performing hazard assessments, dispersion modeling, and consequence analysis.
IEC Regulations
2-Day Course

Program Content:
This course is designed to provide the student with an understanding of how to implement the requirements of the international safety instrumented standard, IEC 61511. The complete Safety Instrumented System (SIS) lifecycle will be covered from the risk assessment through long-term operation and maintenance.

- Overview of the current state of the standards
  - ANSI/ISA S84.01-1996
  - IEC 61508
  - IEC 61511
- Risk assessment
  - Risk analysis and Independent Protection Layer assessment
  - Development of safety functions
  - Safety Integrity Level assignment
    - Modified HAZOP
    - Consequence only
    - ALARP
  - Risk matrix
  - Risk graph
  - LOPA
  - Quantitative Risk Assessment
- Design
  - Safety requirements specification
  - Specific design requirements
  - Installation, commissioning, and validation
  - Operation, maintenance, and testing procedures
- Verification
  - SIL verification
    - Simplified equations
    - Fault tree analysis
    - Markov models
  - Functional safety assessment
  - Fault tolerance
  - Management of Change

Who Should Attend?
Control system engineers, instrument engineers, and process safety specialists.

1.4 CEUs 14 PDHs
Inherently Safer Design
2-Day Course

Program Content:
Inherently safer design focuses on the elimination of hazards from a manufacturing process, rather than the management and control of those hazards. An inherently safer process will be less vulnerable to deterioration and failure of safety management systems and equipment because the hazards of the process have been reduced or eliminated.

The concepts of inherently safer process design are introduced. Implementation of these concepts throughout the process life cycle from early research through an operating plant are discussed. Tools for designing inherently safer processes will be discussed, as well as tools for measuring inherent safety. Many practical examples from industry are given.

Upon completion of this course, the participants will understand the basic concepts of inherently safer design, and be able to apply these concepts to the development of inherently safer chemical process design. Participants will also be able to identify opportunities for improving the inherent safety of existing plants.

Day 1:
- Inherently safer design concepts
- Definitions
- Understanding hazards
- Process safety management strategies
- Inherently safer design strategies
- Minimize, substitute, moderate, simplify
- Industrial examples

Day 2:
- Tools for inherently safer design
- Measuring inherent safety
- Understanding and managing inherent safety conflicts
- Decision making tools
- Design example
- Resources for inherently safer design

Who Should Attend?
This course is designed for process research, design, and manufacturing engineers and chemists involved with the development and operation of chemical handling and processing facilities throughout their life cycle.
Program Content:
This course covers the engineering requirements for the specification, design, implementation, ongoing maintenance, and testing of Safety Instrumented Systems (SIS), also called emergency shutdown systems, interlock systems, or safety shutdown systems in the process industry. The course focuses on the ANSI/ISA S84.01-1996 standard, but also incorporates material from other industry documents as well. Material ranges from assessing process risk, determining need for instrumented safety systems, matching risk levels to safety system performance requirements, pros and cons of different technologies, estimating overall system performance, documentation requirements, field devices, and maintenance issues.

Day 1:
- Introduction
- Methods for evaluating process risk
- Need for safety systems
- Methods for matching process risk to safety performance requirements
- Difference between process control and safety control
- Separation between process control and safety control
- Safety system standards
- Safety system design life cycle
- Safety system technologies
- Field devices application
- Other design issues
- Safety availability and reliability terms and concepts

Day 2:
- Safety system requirements specifications
- Safety system performance considerations
- Determining safety system capability (safety availability, risk reduction potential, estimating nuisance trips)
- Application of ISA TR84.0.02 techniques for evaluating safety system performance
- Calculate the safety availability for a typical SIS
- Evaluate the impact of redundancy diagnostics and common cause on performance
- Examine operation, maintenance, and documentation issues
- Testing requirements
- Management issues
- Perform a risk assessment for a simple process, determine need for SIS and design, and evaluate an SIS to reduce risk to target level

Who Should Attend?
Control system engineers, instrument engineers, and process safety specialists

Note: Course attendees should bring a calculator to class

1.4 CEUs  14 PDHs
Program Content:
The concepts of LNG safety for liquefaction, import terminals, peak shaving, and 
transportation systems are explained in this course. Those involved in LNG project 
development, operations, and safety and risk management are ideally suited to participate. 

An overview of unique LNG hazards, such as LNG release source, pool spreading, vapor 
dispersion, fire and explosion, BLEVE, RPT, rollover, and much more will be detailed. Also 
included are accidents response methods including release detection and post-release 
mitigation, such as dry chemical, foam, and water curtain applications. 

In addition to consequence modeling techniques, basic information on the properties of 
liquefied gases is presented to ensure that students understand the behavior of LNG, 
particularly as it affects the hazards. 

Government and industry codes related to LNG are also discussed, including methods for 
predicting the sizes of hazard zones that could be created by releases on LNG. The results of 
such computations, using sample problems are compared to separation distances 
recommended or required by various codes and standards. 

Course contents include: 
- Properties of LNG 
- Vapor-liquid phase behavior 
- Vapor clouds, pool fires, jet fires, BLEVE hazards 
- Rollover 
- Hazard control systems 
- Dikes, dry chemicals, foam, water curtain, detection 
- US LNG regulations and standards 
- Several consequence models will be used to demonstrate LNG hazard control 

Who Should Attend? 
All engineers and individuals, including safety and SHE personnel, involved with the design, 
operation, and maintenance of LNG/LPG facilities including LNG/LPG plants, storage, 
transportation, receiving terminals, and re-vaporization facilities.
Program Content:
Streamlined Reliability-Centered Maintenance (RCM) is a practical, systematic procedure that allows you to optimize your Preventive Maintenance (PM) efforts, your overall maintenance efforts, and your overall maintenance program. RCM will give you a sound basis for deciding where and when not to allocate your limited maintenance dollars. By attending this practical workshop, you will discover why streamlined RCM is so cost-effective and easy to apply, and how to take advantage of its substantial benefits: increased equipment reliability and uptime, getting the maximum benefit from your limited maintenance budget, achieving the best balance of preventive and run-to-failure maintenance, assurance that you will be performing all the essential, worthwhile PM activities, quick payback, flexibility that promotes continuous improvement, and a safer workplace.

Planned and scheduled maintenance, which requires an effective preventive maintenance program, is much more efficient than breakdown maintenance in terms of downtime, overall costs, or any other measure of performance. This workshop will show how streamlined RCM can improve your existing preventive maintenance program, or help you develop the best possible new program starting from scratch. You can apply RCM to a single piece of equipment or to an entire process.

Day 1:
• Introduction—terms and concepts
• Streamlined RCM process
• Starting the process
• Equipment risk ranking
• Identification of potential reliability Improvement actions (task analysis)
• Collection of existing recurring task data

Day 2:
• Finalizing reliability improvement recommendations
• Implementing your reliability and improvement recommendations
• Measuring your success
• RCM project staffing and management guidelines
• Continuous improvement guidelines
• Summary and review

Who Should Attend?
Maintenance supervisors, production supervisors, plant engineers, plant managers, and others with responsibilities for operations or maintenance.

1.4 CEUs
14 PDHs
Program Content:

The OSHA 1910.119 Process Safety Management (PSM) mandate of 1993 brought safety to the forefront of our businesses. Along with many other pieces of critical process safety information, it demanded adequate verification and documentation of the design basis for all new and existing pressure relief and disposal systems. However, it did not outline how to do this nor what constitute “adequate” documentation. Due to imposed deadlines that quickly approached, companies rushed to be in compliance.

In the mid-1990’s, most would argue that there was not enough time nor money budgeted to carry out the huge scope of work that OSHA 1910.119 called for. Consider for a moment the operations of one of the larger refineries (~300,000 BPD) in the United States and read the following questions:

- How does this refinery identify, analyze, and maintain all of the equipment, relief device and process information associated with 5,000 pieces of equipment, 20,000 overpressure scenarios, and millions of flare venting combinations?
- How does this refinery ensure that all pressure relief and disposal system information is accurate, accessible, and maintainable?
- How does this refinery do all of the above without incurring astronomical costs?

Approximately twenty years after the initial push for compliance and the implementation of the OSHA National Emphasis Program (NEP), companies have some breathing room to re-ask themselves the above questions. The answers are the best practices covered in this course. The ultimate goal is a corporate-wide standardization of philosophy, engineering analysis, software, and information management that guarantees an accurately designed, electronically documented, and easily maintained pressure relief and disposal system for an acceptable dollar investment. These best practices outline how to achieve this goal:

- Adoption of a sensible approach to risk management
- Commitment to best practices
- Standardization of equipment-based engineering analysis
- Identifying and implementing appropriate Recognized and Generally Accepted Good Engineering Practices (RAGAGEPs)
- Standardization of relational database and integrated information management architecture
- Coupling of pressure relief and disposal system documentation to Management of Change processes
- Relief device inspection program
- Relief device removal procedures
Who Should Attend?
This course outlines the best practices of pressure relief design so it is primarily intended for personnel who have the responsibility of maintaining and auditing the pressure relief system design basis documentation for OSHA 1910.119 compliance. The intended audience includes auditors, process engineers, technical managers, and project managers.
Program Content:
As an introduction to reactivity of industrial chemicals and the evaluation of potential hazards due to their reactive nature, this course discusses identification and characterization of chemical hazards. Also discussed is the use of a hierarchical evaluation and management approach for safer and more economical chemical processes.

- Why a systematic approach to chemical reactivity is important
- Why reactive hazard management should include management of risk
- Definition of a potentially hazardous reactivity
- Types of chemicals and chemical reactions
- Chemical incompatibility
- Chemical energy of formation and potential release of energy
- Effects of catalysis, inhibitors, contaminants, and corrosion products
- Reaction conditions, including temperature, pressure, concentration, and time
- Equipment reliability and availability including failure, testing, and repair
- Systematic prediction of potential chemical hazards using literature information, computation methods, screen testing, and detailed experimental analysis
- Industrial case studies illustrating effects of energy, reaction pathways, unexpected reactions, kinetics, and aging

Who Should Attend?
Reactive hazards analysts, process safety managers and coordinators, and operation managers and superintendents.

Note: This class is also available as a two-day class.
Program Content:
This course is an introduction to chemical reactivity and the evaluation of potential hazards of industrial chemicals because of their reactivity. The purpose of this course is to provide a basis for evaluating chemicals that will be used in the operation of safe and economical chemical process plants.

Recent accidents involving reactive chemicals are reviewed in the context of regulatory requirements and industry procedures. Also summaries of recent regulatory activity regarding reactive chemicals is provided. The intent of the course is to have the attendees leave with an understanding of a structured, hierarchical approach to evaluating potential hazards of reactive chemicals.

Day 1:
- Why a systematic approach to chemical reactivity is important
- Definition of a reactive chemical or potentially hazardous reactivity
- Regulatory history including the General Duty Clause
- Recent regulatory activity. Types of chemicals and chemical reactions
- Chemical incompatibility
- Chemical energy of formation and potential release of energy
- Reaction activation energy
- Effects of catalysis, inhibitors, contaminants, and corrosion products
- Reaction conditions, including temperature concentration, and time
- The role of equipment and process design
- Identification of chemical nature and potential for exothermic reactions
- Chemical bond types and structures associated with chemical behavior

Day 2:
- Systematic prediction of potential chemical hazards using literature information, commercial software, computational methods, screening experiments, and detailed experimental analysis
- Discussion and analyses of industrial case histories illustrating effects of energy, reaction pathways, unexpected reactions, kinetics, and aging
- Case histories to be analyzed include Concept Sciences, Nissin Chemical, Napp Technologies, and Morton International

Who Should Attend?
The course content is diverse enough for use by anyone involved in evaluating chemical reactivity. Operations personnel who must deal with these issues on a day-to-day basis, as well as personnel involved in implementing process safety management programs would benefit from this course.

Note: This class is also available as a one-day class.
Reducing Human Error in Process Safety
1-Day Course

Program Content:
It is widely recognized that human error is one of the commonest underlying causes of process accidents, accounting for up to 90% of the underlying causes of major process accidents, such as Texas City, Piper Alpha the Phillips 66 explosion. Nevertheless, the training provided for most engineers tends to ignore this important topic because it is assumed that human fallibility is inevitable and cannot be reduced by the application of systematic design-based approaches. This course questions this assumption by providing an overview and experience of tools, techniques and knowledge developed over the past 30 years which allows human error, like any other hazard, to be managed.

The purpose of the course is to provide an appreciation of the main factors which contribute to human error in process operations, together with case studies and workshops to support participants in developing error reduction programs in their own organizations. The course will also show how human error analysis tools can be integrated into engineering risk assessment methods such as Process Hazard Analysis and HAZOPs.

The course contents are broadly based on a standard text written by one of the instructors: ‘Guidelines for Reducing Human Error in Process Safety. This textbook will be available to the participants at a concessional rate, if required. However, full course notes will also be provided.

- An engineer’s view of human error
- Main application areas for human factors in process safety
- Case studies: Longford, Texaco refinery
- Why do people make errors?
- Types of error: Slips, Mistakes and Violations
- Video: ‘A Fall From Grace,’ a dramatic film illustrating the mechanisms of human error
- Applying our knowledge of human behavior to error prevention
- Preventing procedures violations by developing best practices and active participation of the workforce
- Getting at the underlying causes of error leading to accidents and near misses
- Integrating human factors analyses into PHA and other formal safety analysis tools

Who Should Attend?
Process safety management coordinators, risk management planning coordinators, and new health, safety, and environment auditors.

0.7 CEUs
7 PDHs
Program Content:

Human error is a significant source of risk within any organization; however this is especially true for high-hazard industries with distributed employees working in remote locations. Management uses a variety of operational controls and barriers, including policies, procedures, work instructions, employee selection and training, auditing, etc., to reduce the likelihood of human error. Accidents occur when there is a failure in one or more of these controls and/or barriers.

Many companies are working to reduce their incident rates by integrating a more detailed analysis of human factors into their incident investigation procedures. In doing so, companies can identify weaknesses in their operational controls at a specific job site, within an operating region, and across the organization. Subsequent improvements to these controls will then help to reduce the on.

The following two-day course will outline a process that companies can use to integrate human factor data into incident investigations and identify operational controls that need improvement. The morning of Day 1 will be used to provide background information on accident causation theory and the basis for integrating human factor analyses into incident investigations. The afternoon of Day 1 will be used to review an incident using human factor considerations. Day 2 will be used to conduct additional incident reviews and to analyze the results in terms on Qatar Petroleum’s safety management system.

Day 1 (8 hours)
- Introductions and Course Objectives (15 min)
- Preliminary discussion of Qatar Petroleum’s incident investigation practices (30 min)
- Introduction to Accident Causation Theories (1.5 hour)
- Break (15 min)
- Overview of Human Performance Reliability Review Process and Tools (1 hour)
- Lunch (1 hour)
- Review Incident No. 1 (3 hours)
- Summary and wrap up (30 min)

Day 2 (7 hours)
- Review of Day 1 materials, answer questions and provide clarification (30 min)
- Review Incident No. 2 (3 hours)
- Lunch (1 hour)
- Aligning incident review data to Qatar Petroleum’s safety management system (2 hours)
- Summary and wrap up (30 min)

Who Should Attend?

This course is targeted to personnel who would function on root cause incident investigation teams, or who would have need to effectively evaluate, review, and approve results of root cause investigations.
Program Content:
This course is a comprehensive introduction and overview of the key tools, techniques, and methods used in root cause incident investigation. This course is focused on chemical process incidents, but is also applicable to a wide variety of accidents and other mishaps with undesirable outcomes. The foundation of the course is based on root cause investigation principles and best practices contained in investigation guidelines published by the Center for Chemical Process Safety (CCPS), National Fire Protection Association Guideline 921, and the Incident Investigation chapter from Lees’ Loss Prevention in the Chemical Process Industry (Third Edition).

The objective of this course is for participants to be able to function successfully on root cause investigation teams and to effectively evaluate the results of root cause investigations to determine if the investigation reached the root cause level. At the conclusion of this course participants should be able to:

- Identify and understand the value of reaching the root cause level in incident investigations
- Distinguish root causes from non-root causes
- Evaluate the recommended preventive actions to determine if the recommendations adequately address root causes of the incident

This course addresses root cause investigation concepts and tools such as evidence identification, evidence collection and management, logic diagrams, timeline, fact-hypothesis matrix, witness interviews, human factors and human reliability issues, and developing effective recommendations. It is important to note that this is not a course in root cause analysis, but instead focuses on the application of root cause concepts to incident investigations.

Who Should Attend?
This course is targeted to personnel who would function on root cause incident investigation teams, or who would have need to effectively evaluate, review, and approve results of root cause investigations.
Program Content:

Terrorism is a serious threat to the security of the chemical and energy infrastructure and indeed the world. The vulnerability of societies to terrorist attacks on the chemical and energy infrastructure results in part from the prolific and common usage of chemical and energy systems, but it also is a consequence of the highly efficient and interconnected systems that we rely on for key services such as transportation, information, energy, and health care. The efficient functioning of these systems reflects great technological achievements of the past century, but interconnectedness within and across systems also means that infrastructures are vulnerable to local disruptions, which could lead to widespread or catastrophic failures. As terrorists seek to exploit these vulnerabilities, it is fitting that we harness our scientific and technological capabilities to counter terrorist threats.

This course describes many ways in which science and engineering can contribute to making the chemical and energy infrastructure safer against the threat of catastrophic terrorism. The course identifies key actions that can be undertaken now, based on knowledge and technologies in hand, and, equally important, describes key opportunities for reducing current and future risks even further through longer-term research and development activities. However, science and technology are but one element in a broad array of potential approaches to reducing the threat of terrorism.

Our society is too complex and interconnected to defend against all possible threats. As some threats are diminished others may arise; terrorists may change their goals and tactics. While this course describes what are the top-priority actions and objectives for harnessing science and technology to meet today’s threats, its most important conclusion is that the chemical and energy infrastructure needs a well-organized and disciplined ability to respond as circumstances change. In that sense this is not an enduring plan for technical work, but rather a starting point from which the chemical and energy infrastructure can create defenses-in-depth against the new threat. For that reason it is especially important that strengthening programmatic long-term efforts that can create new solutions should be a cornerstone of the strategy for countering terrorism.

Key elements or infrastructures of society can be means of attack, targets, and means of response. Programmatic development of chemical security programs requires in-depth planning and execution in four areas, i.e., prevention, mitigation, response, and recovery. While some systems and technologies can be classified roughly in one category or another, most systems and technologies can fit into multiple categories. Based on an understanding of the difficulty of launching particular kinds of attacks and the feasibility of limiting the damage of such attacks and of recovering from them, it is possible to prioritize long-term actions and programs needed to protect the chemical and energy infrastructure.

Who Should Attend?

This course is primarily designed to meet the needs of all personnel involved in developing and implementing programs for the protection of the chemical and energy infrastructure, as well as for production, design, maintenance, as well as members of the Health & Safety & Environment department.
Disposal Systems Analysis—Best Practices
1-Day Course

Program Content:
The OSHA 1910.119 Process Safety Management (PSM) mandate of 1993 brought safety to the forefront of our businesses. Along with many other pieces of critical process safety information, it demanded adequate verification and documentation of the design basis for all safety disposal system components. However, it did not outline how to do this nor what constitute “adequate” documentation. Due to imposed deadlines that quickly approached, companies rushed to be in compliance.

The primary goal of a disposal system, such as flare, analysis is to ensure that all processes are adequately protected against potential global overpressure contingencies. The design basis of flare relief header system components such as pressure relief devices, piping network, knockout drums, flare seals, and flare tip should always be available and this data should reflect the current operating condition of the process.

In recent years, refining and petrochemical facilities have experienced tremendous growth in response to increasing demand for fuels and chemical precursors. At the same time higher expectations were established to be in compliance with corporate, local, and federal regulations. Under these circumstances it has become more challenging to keep an eye on the update and maintenance of the flare header adequacy analysis during fast paced engineering design and debottlenecking projects. The challenge stems from the time and cost requirements that are associated with such an effort.

This course describes a best practice to analyze disposal systems that will provides refining, petrochemical and chemical facilities operators and managers with comprehensive plan to efficiently maintain and reflect the adequacy status of the flare system components. The course outlines the following components:

- Commitment to best practices and adoption of a sensible approach to risk management
- Standardization of disposal systems analysis
- Identifying and implementing appropriate Recognized and Generally Accepted Good Engineering Practices (RAGAGEPs)
- Standardization of relational database and integrated information management architecture
- Disposal system components engineering analysis
- Flare quantitative risk analysis (QRA) and flare consolidation

Who Should Attend?
This course outlines the best practices of pressure relief design so it is primarily intended for personnel who have the responsibility of maintaining and auditing the pressure relief system design basis documentation for OSHA 1910.119 compliance. The intended audience includes auditors, process engineers, technical manages, and project managers.
Program Content:
Alarm Management has become a very important topic since the Honeywell Abnormal Situation Management Consortium estimated billions of dollars in annual losses in the US Chemical and Petroleum industry due to incorrect actions in abnormal operations. A 5-10% increase in profitability can be attained with good alarm management and reducing unplanned shutdowns.

The relationship of Alarm Management to Process Safety Management and Safety Instrumented Systems technologies will be defined. The latest ideas in critical condition monitoring, fault detection techniques, and decision support will be presented.

Techniques for alarm rationalization, redesigning, and operator assistance are described. A systematic program for alarm rationalization studies will be presented. Understanding alarm flood, tools for alarm rationalization, and human factor aspects of control room staffing will also be presented. Demonstration of software necessary for effective alarm management and fault detection projects will be featured.

Who Should Attend?
PSM managers, alarms specialists, SIS design and maintenance personnel, instrumentation and controls engineers and specialists.
Area Classification and Management
2-Day Course

Program Content:
Area Classification is an important topic at this time because it is essential to meet OSHA Process Safety Management requirements as indicated in 29 CFR 1910.119. It is more important because of safety, National Electric Code (NEC) compliance, and economic reasons. The engineering spent on classification has a fast payout. In this era of world competition, companies cannot afford financially or legally to “short-change” classification. Recent additions to the 1996 NEC emphasize the importance of area classification drawings.

This course provides a comprehensive comparison of the types of Area Classification for chemical and petroleum processes and highlights the differences and, in particular, the application variations of NFPA 497A and API RP500. The complexities in applying these standards will be discussed. Finally, the course also presents a technique that meets OSHA Process Safety Management requirements and has other significant advantages. In addition, in Europe the ATEX directives require stringent attention to Area Classification.

It is the purpose of this course to share ideas on classification and to present and discuss examples of classification drawings that will be useful to those involved in this important task.

Who Should Attend?
This course is intended for those people who are involved in determining and implementing area classification plans, operations and maintenance personnel required to comply with area classification policies and procedures, PSM coordinators, and PSM auditors.
Program Content:
A review of the elements common to successful behavioral safety processes and address specific issues critical for sustaining long-term success is provided. Special topics include achieving effective teamwork, management’s role in behavioral safety, how to maintain the enthusiasm and active support of observers, increasing employee participation, performance scorecards and other measurement systems, effective reinforcement plans, how to include lone-workers in the process, integrating ergonomics into behavioral safety processes, relating to other processes such as Six Sigma, and the prevention of high-consequence incidents. The management approach presented in the workshop has proven effective in not only substantially reducing injury rates, but also in preventing incidents that result in property damage, business interruption, hazardous material releases, regulatory agency violations, and other incidents with potential for serious consequences.


Who Should Attend?
Human factors specialists, PSM coordinators and managers, SHE coordinators and managers, front-line operations, and maintenance supervisors.
Program Content:
This course is an advanced course on consequence modeling which builds on the concepts introduced in course number 4022. Detailed descriptions of the fundamentals and mathematical formulation of scenarios for consequence modeling are developed and explained as they relate to the process industry. Case histories from accidents in the petrochemical industry, hydrocarbon and refining industry, oil and gas industry, chemicals, and offshore industry are used to expound the problems.

The effects of facility layout, siting, and other site-specific issues such as congestion and confinement are dealt with in detail. Theoretical research and experimental data is used to support the choice of mathematical models for specific applications. Examples of actual accidents illustrate and validate the models used.

Participants get the opportunity of developing problems from complete scenario analysis, model development, and calculations. Based on the calculations, participants learn to develop and implement design changes, operational and maintenance changes, emergency response planning, and other remedial measures in order to reduce the probability of the incident and consequence of occurrence.

Participants get to use a range of computer models starting from simple conservative models to complex and realistic models. The computer models include integral models as well as computational fluid dynamics models.

Who Should Attend?
This course is intended for engineers and safety professionals who are required to understand and quantify the effects of accidental releases that result in toxic and flammable vapor clouds, explosions, and BLEVEs with fireballs.
Electrostatic Hazards
2-Day Course

Program Content:
This course will be an introduction of the scope of beneficial and unwanted or potentially hazardous static phenomena.

Day 1:
- Review applied electrostatic concepts
- Development of charge transport conservation equations for flowing fluids with applications
- The nature of colloids and interfaces

Day 2:
- The use of dimensional analysis to analyze experimental data obtained on the study of complex single and two-phase media
- Experimental techniques for measurement of physicochemical parameters (electrical conductivity, dielectric constant, Zeta Potential, etc.)
- Charge generation and creation of hazardous atmospheres for combustibles
- Industrial electrically enhanced separations and particulate control

Who Should Attend?
This course is intended for those people who are involved in developing and implementing compliance programs for electrostatic hazards, operations, and maintenance personnel, who deal with and respond to electrostatic problems, design engineers who must take into account electrostatic hazards in their design, PSM coordinators, and PSM auditors.
Program Content:
This course will discuss and exercise decision making examples using decision tree figures and other tools to analyze decision alternative outcomes and probabilities including the likelihood of observing particular outcomes in tests to lower uncertainty for more accurate decision making.

Course topics include:
- Method and components of an engineering decision
- ‘Flaw of averages’ and the importance of working with variability of critical parameters
- Use of probability to model uncertain events and guide uncertainty reduction
- Expected likelihood and expected utility of alternative outcomes
- Value of information and method to determine how much additional information, if any, is needed prior to making an engineering decision, and the value of perfect information to find the value limit of additional information to make a given decision
- Bayes Model to update probability estimates using new information
- How to calibrate engineering decisions based on tolerable risk ranges

Information gathering, analysis, and decision making are vital components of engineering responsibility. This responsibility includes the value of information to decrease uncertainty for cost effective decrease of outcome risk. Such decisions employ information to estimate values and outcome probabilities of decision alternatives. Therefore, the pillars of engineering decision making are the values and probabilities of alternative outcomes. Exercises and case studies drawn from life and from engineering applications will illustrate the tools needed for professional decision making applications. Case studies include natural gas or oil drilling, building extension and rebuilding, toxic exposures, dikes to avoid flooding, replacement of leaking pipeline, and offshore platforms.

Who Should Attend?
All engineering personnel (design, operations, maintenance) who are involved in day-to-day operations and decision making in the plants. In addition, all project managers should attend this course.

Note: This class is also available as a two-day class.
Program Content:
This course will discuss and exercise decision making examples using decision tree figures and other tools to analyze decision alternative outcomes and probabilities including the likelihood of observing particular outcomes in tests to lower uncertainty for more accurate decision making.

Course topics include:
- Method and components of an engineering decision
- ‘Flaw of averages’ and the importance of working with variability of critical parameters
- Use of probability to model uncertain events and guide uncertainty reduction
- Expected likelihood and expected utility of alternative outcomes
- Value of information and method to determine how much additional information, if any, is needed prior to making an engineering decision, and the value of perfect information to find the value limit of additional information to make a given decision
- Bayes Model to update probability estimates using new information
- How to calibrate engineering decisions based on tolerable risk ranges

Information gathering, analysis, and decision making are vital components of engineering responsibility. This responsibility includes the value of information to decrease uncertainty for cost effective decrease of outcome risk. Such decisions employ information to estimate values and outcome probabilities of decision alternatives. Therefore, the pillars of engineering decision making are the values and probabilities of alternative outcomes. Exercises and case studies drawn from life and from engineering applications will illustrate the tools needed for professional decision making applications. Case studies include natural gas or oil drilling, building extension and rebuilding, toxic exposures, dikes to avoid flooding, replacement of leaking pipeline, and offshore platforms.

Who Should Attend?
All engineering personnel (design, operations, maintenance) who are involved in day-to-day operations and decision making in the plants. In addition, all project managers should attend this course.

Note: This class is also available as a one-day class.
Gas Explosion Hazards on Offshore Facilities
2-Day Course

Program Content:
An advanced course looking into explosion hazards on offshore facilities. The course addresses all aspects of explosion hazards: ignition processes, release and dispersion, explosion mechanisms, blast loads and modeling of all these aspects. On the second day, a tour of the TEEX Brayton Fire Training Field and Disaster City. Course attendants will experience at least one large-scale fire demonstration.

Day 1:
- Gas Explosion Basics
- Explosion Accidents: Statistics and Examples
- Rough Offshore Explosion and Investigation
- Release and Dispersion in Offshore Facilities
- Ignition Sources—Fundamentals
- Preventative Measures
- Mitigation and Control

Day 2:
- North Sea—Lessons Learned
- Advanced Explosion Modeling
- Explosion Analyses
  - Part 1: Objective and Motivation
  - Part 2: Explosion Risk Analyses—Simple Approach
  - Part 3: Explosion Risk Analyses—Advanced Approach
  - Part 4: Selected Examples of Safety Case Analyses

Who Should Attend?
Safety engineers, safety consultants, structural & design engineers, oil & gas HSE, investigation team leaders, and process safety management coordinators.
Program Content:
This course encompasses liquefied gases that are normally handled as refrigerated liquids and those that are commonly handled under pressure. Whether pressurized or refrigerated, liquefied gasses are high volatility chemicals and, if released to the atmosphere, can create significant safety hazards. These hazards can have an impact on both the liquefied gas plant and the public near the plant. As a consequence, within the liquefied gas industry, special emphasis has been placed on the safety of facilities and transportation systems. Additionally, in recent years, regulatory bodies have become actively involved in liquefied gas safety issues and the design and operation of liquefied gas facilities.

The intent of this course is to provide the participant with basic background information of properties of liquefied gases, liquefied gas-handling systems, and liquefied gas hazards. The developments of liquefied gas facility design standards, especially those relating to safety, are discussed. Techniques for evaluating potential hazards and hazard control techniques are presented.

The course attempts to address both the present state-of-the-art and the historical development of safety technology in the liquefied gas industry. Significant developments have occurred in this technology over the past five years. A large amount of research is being undertaken at this time to better quantify liquefied gas hazards. Operators of liquefied gas facilities are reviewing their designs to further improve facility safety. This course is continually being updated in order to provide the course participant with the most current information available.

The course deals primarily with those liquefied gases that are flammable, with particular emphasis on LNG and LPG. This is due to the magnitude of the LNG and LPG industries and to the fact that, from a fire safety viewpoint, these liquefied gases have been most heavily studied. However, most of the course material is presented in such a manner that it is applicable to other flammable liquefied gases.

Who Should Attend?
All engineers and individuals (including safety and SHE personnel) involved with the design, operation, and maintenance of LNG/LPG facilities including LNG/LPG plants, storage, transportation, receiving terminals, and re-vaporization facilities.
Program Content:
This course is concerned with all aspects of Chemical Process Safety and Loss Prevention. Process Safety is concerned primarily with the identification of potential hazards and hazardous conditions associated with the processes and equipment involved in the Chemical Process Industries, and methods of predicting the possible severity of these hazards and preventing, controlling, or mitigating them. As such, it is necessary to understand the operation of these processes and the equipment, and to apply sound engineering fundamentals to the analysis and prediction of performance, under adverse circumstances. Thus, the course emphasizes quantitative engineering analysis, based upon the applications of mass and energy balance, fluid mechanics of liquid, gas, and two-phase flows, heat transfer and the conservation of energy, mass transfer, diffusion and dispersion under highly variable conditions, reaction kinetics, process control, and statistics.

- Introduction—Process Safety Management
  - Failure
  - Management responsibility, policy
  - Hazard identification
  - Hazard assessment
  - Hazard control
- Introduction to Process Safety Engineering
- Loss Prevention
- Application of fundamental engineering principles
- Toxic materials—introduction
  - Dose and response curves
  - Threshold limit values & permissible exposure levels
  - Application of engineering principles—problems
- Introduction to hygiene
  - MSDSs
  - Monitoring volatile toxicants
  - Liquid vaporization rates
  - Applications—problems
- Source models
  - Application of fluid mechanics to leakages
  - Through holes, pipes, and fittings
  - Evaporation, flashing, and boiling
  - Two phase flow
  - Applications—problems
  - Toxic release and dispersion
  - Dispersion models
  - Pasquill-Gifford plume and puff models
  - Computer applications
- Fires and explosions
  - Flammability of liquids and vapors
  - Minimum oxygen concentration, ignition
  - Explosions—detonation and deflagrations
  - Blast damage
  - Applications—problems
- Fire and explosion protection and prevention
  - Inerting, purging
Loss Prevention for the Process Industry—Advanced (Cont.)
5-Day Course

- Static electricity
- Explosion proof equipment
- Ventilation, sprinklers
- Applications—problems
- Reliefs
  - Location, types, systems
  - Knockout drums
  - Flares
  - Scrubbers, condensers
  - Applications—problems
- Relief sizing
  - Spring operated, rupture discs
  - Design for liquid, vapor, two-phase flow
  - Venting for dust and vapor
  - Thermal expansion
  - Applications—problems
- Hazard identification
  - Checklists
  - Dow Fire and Explosion Index
  - HAZOP
  - Safety reviews
  - Applications—problems
- Risk assessment
  - Probability theory
  - Interactions between units
  - Event trees
  - Fault trees
- Accident investigations
  - Procedures
  - Diagnosis
  - Recommendations

Who Should Attend?
This course is primarily designed to meet the needs of all personnel involved in every level of onshore and offshore process operations, production, design, maintenance, as well as members of the health, safety, and environmental department.
Program Content:

How do you answer the following questions?

- I’ve done hazard studies, but how do I know if my process is safe enough?
- There are different risk mitigation strategies for a given hazards. Which is best?
- How often should I test my safety interlock system?
- How do I maximize the safety benefits for each safety dollar invested?

Using a quantitative approach to risk assessment helps you to answer questions such as these. This course introduces the Fault Tree Analysis (FTA) approach to Quantitative Risk Assessment (QRA) through a combination of discussion and hands-on practice examples for the following topics.

- Hazard identification
- Relative risk and design targets
- Basic Fault Tree structures
- Understanding and modeling process cause and effect behaviors
- Process control loops, alarms, interlock systems, and operating procedures
- Converting process and control systems understanding into Fault Trees
- Human factors
- Basic failure rate probability and statistics calculations
- Data requirements and resources
- Assigning failure event probabilities and calculating the minimum cut sets
- Identifying common cause failures

Who Should Attend?

Design engineers, process safety managers, HSE managers, and risk assessment specialists.
Root Cause Incident Investigation
2-Day Course

Program Content:
The objective of this course is for the participant to understand root cause incident investigation techniques for chemical process incidents.

This course is intended for technical personnel who will lead or participate in root cause investigations of chemical process incidents. It presents an overview of key concepts for root cause investigation through a series of class exercises, video, and discussions. This course is based on investigation guidelines published by the Center for Chemical Process Safety (CCPS), and industry practices for root cause analysis.

Day 1:
- Investigation models
- Definitions & key concepts
- Class exercise in critical thinking and logic
- Examples of deductive investigative approaches
- The Incident Investigation Management System
- Root cause tools
- Class exercise in timeline application
- Class exercise in logic diagram application

Day 2:
- Evidence-gathering, identifying, preserving and analyzing
- Witness interview workshop
- Developing root cause recommendations
- Effective incident reporting
- Case study-root causes of classic process incidents (Piper Alpha, Three Mile Island, Flixborough, Bhopal and others)
- Practical applications of root cause concepts

Who Should Attend?
Safety engineers, investigation team leaders, and process safety management coordinators.

1.4 CEUs 14 PDHs
Program Content:
An advanced course looking into explosion hazards for LNG facilities. The course addresses all aspects of explosion hazards: LNG release and dispersion, explosion modeling, mitigation, preventive measures, probabilistic risk assessments, legislation, accidents, selected cases, outlooks and modeling of all these aspects.

Day 1:
- Fundamentals of LNG
- LNG Safety Regulations
- Gas Explosion Basics
- LNG Accidents: History
- LNG Accident Consequence Models
- Preventative Measures
- Mitigation and Control
- Quantitative Risk Assessment Methodology

Day 2:
- Analysis—Case Studies
  - Part 1: Objective and Motivation
  - Part 2: Explosion Risk Analyses
  - Part 3: Onshore Regasification Plants
  - Part 4: Onshore Liquefaction Plants
  - Part 5: Offshore LNG—Production and Regasification

Who Should Attend?
Safety engineers, safety consultants, structural & design engineers, oil & gas HSE, investigation team leaders, and process safety management coordinators.
Program Content:

The essential issue with the concept of multiple barriers and inherent safety is that the focus should be on reducing or eliminating hazards by changing the materials, chemistry, and process variables such that the reduced hazard is characteristic of the new conditions. This compares with adding layers of safety to a process to reduce the risk but not reducing the nature of the hazard directly.

The development of a system’s technical, managerial, and financial ability to provide safe system is the foundation of a successful multiple barriers approach for any system. A safe process is essential to the productivity and sustainability of any plant or process. A chemical process is vulnerable to failure from many potential threats. The objective of a multiple barriers approach is to create a coordinated set of programs and requirements to help the plant to reduce the probability of incidents and reduce the consequences if incidents do occur.

By placing integrated barriers from the source to the product can help chemical plants reduce the probability of incidents and reduce the consequences. A successful multiple barrier approach includes:

- Barriers between potential threats and the outcome.
  - Prevention activities such as identifying and reducing probability of scenarios.
  - Appropriate inherently safer options.
  - Properly trained, certified operators.
  - Properly designed and constructed facilities.

- Programs and activities to make sure the barriers are in place and operational.
  - Surveys to evaluate the adequacy of prevention programs.
  - Comprehensive Performance Evaluations to identify potential cost-effective improvements in system performance.
  - Standards for the design and construction of a system’s components.
  - Continuing education and training of manager and certified operators.
  - Strategic and emergency response planning to make sure a system is prepared for the future and for potential crises or disasters.
Safety Culture
2-Day Course

Program Content Coming Soon!

1.4 CEUs  14 PDHs
Program Content:

Process safety is a relatively new discipline that is gradually gaining more and more significance driven by recent events, public pressures, risk perception, and sustainability issues. This course covers the evolution of process safety, development and implementation of various regulations worldwide and the performance-based nature of process safety. Recent developments resulting from various drivers are also discussed in detail.

During the 80’s and 90’s a number of catastrophic events led to the promulgation of regulations and standards with regard to process safety. Prior to these programs, process safety was mostly practiced on an ad hoc basis depending on company culture and business objectives. Two new areas that have received a lot of attention starting the late 1990’s are inherent safety and reactive chemicals.

Inherent safety has been recognized as a design approach useful to remove or reduce hazards at the source instead of controlling them with add-on protective barriers. It is widely accepted as a good engineering practice. However, inherent safety is based on qualitative principles that cannot easily be evaluated and analyzed, and this is one of the major difficulties for the systematic application and quantification of inherent safety in plant design. During the last few years, several measurement techniques and analysis tools have been developed to estimate the degree of inherent safety of a plant or a process unit. A more ambitious goal of inherent safety programs is to break the traditional boundaries of safety ideology associated with the idea that safety is subjective and hence non-quantifiable.

The principle of inherently safer design is the cheapest if applied at the early stage of process development and design. The integration of safety into process design and optimization is highly desired. This course discusses procedures for integrating safety into design and optimization framework.

Process safety has been emphasized in the petroleum refining and petrochemical industry over the decades. This is especially true in the refinery unit processes, where reactive and hazardous materials are handled at elevated temperatures and pressures. The guiding principles of inherent safety have been clearly illustrated by Trevor Kletz. While there is no argument against the concepts of inherent safety principles, the application of these principles often gives rise to a discussion of overall risk.

Another recent area of interest in process safety is reactive chemicals. This course also includes a structured approach for the evaluation of reactive chemical hazards that integrates literature data screening, computational estimations, theoretical modeling, and experimental measurements. The main goal of this systematic approach is to focus the analysis on the most likely and most hazardous reaction stoichiometry and hence reduce the need for detailed experimental analysis for a large number of process reactions. More detailed and advanced experimental analyses may be required for the more complex and reactive systems.
Other recent developments presented in this course include:

- The development and implementation of facility siting standards, fatigue standards, metrics and performance measurements standards following the BP Texas City incident,
- The development and implementation of chemical security procedures and technology following the 9/11 events,
- The development of new issues and programs following offshore incidents particularly the Macondo Gulf incident in the USA,
- The development of linkage of process safety with sustainability issues, and
- The growing debate on risk perception issues and the role played by society in such issues.

It is the purpose of this course to share recent developments in process safety and to present and discuss examples of dealing with and adjusting to the ever-changing requirements and objectives. During the whole course, a number of case histories are used to illustrate the course topics.

**Who Should Attend?**

This course is primarily designed to meet the needs of all personnel involved in every level of onshore and offshore process operations, production, design, maintenance as well as members of the Health & Safety & Environmental department.
Dust Explosion Hazards
2-Day Course

Program Content:
An advanced course looking into dust explosion hazards. The course addresses all aspects of dust explosion hazards: dust properties, explosion modeling, preventive measures, ignition sources, protective measures, process hazard analysis, legislation, accidents, selected cases, outlooks and modeling of all these aspects. Course attendants will experience a small-scale explosion demonstration.

Day 1:
- Dust Explosion Accidents
- Dust Explosion Basics and Dust Explosion Characteristics
- Ignition Sources
- Lessons Learned: Legislation and Standards
- Preventive Measures
- Preventative Measures
  - Part 1: Introduction
  - Part 2: How to Perform a Hazardous Area Classification
  - Part 3: Avoidance of Ignition Sources
  - Part 4: Housekeeping

Day 2:
- Protective Measures
  - Part 1: Introduction
  - Part 2: Dust Explosion Venting Design
  - Part 3: Dust Explosion Suppression Design
  - Part 4: Dust Explosion Isolation
- Dust Explosion Process Hazard Analysis
- Dust Explosion Modeling

Who Should Attend?
Safety engineers, safety consultants, structural & design engineers, oil & gas HSE, investigation team leaders, and process safety management coordinators.

1.4 CEUs 14 PDHs
Program Content:
The primary objective of this course is to offer fundamental understanding on blast and fire engineering that can be applied for both onshore and offshore oil and gas structures. The course content encompasses the state-of-the-art methods developed for analyzing blast and fire events and their influence on human and infrastructures. This course will not only enhance the capacity of participants on basic principles applied to blast and fire engineering, but also will provide them with numerous practical applications by pulling in real-world problems accomplished in each area. The course content is summarized in below:

Different methods for computing the blast load on structures will be discussed. The semi-empirical and computational fluid dynamics (CFD) approaches for simulating blast phenomenon and blast-structure interaction effects will be outlined. The methodologies for determining the blast loads on structures by taking into account the interaction between structure and blast wave, i.e. the effect of wave reflection from surface of structure and clearing effects, will be explained. A quantitative risk assessment procedures will be outlined to identify blast exceedance curves. The method for interpretation of pressure/impulse exceedance curves in order to determine the blast loads will also be described. Further, a risk-based approach to design and assess onshore and offshore structures for blast loading will be presented.

The performance criteria and its different categories under blast loading will be presented. The performance criteria will include various structural components and their detailing in different types of structures. In addition, the performance criteria will encompasses non-structural items in different types of buildings, i.e. doors, windows, openings, and interior details. Subsequently, the building occupant vulnerability to blast load will be explained. The fatality/lethality curves and the methods for estimating maximum individual risks will be presented.

A methodology for computing structural response of piping and pressure vessels to blast loading in offshore structures and petrochemical facilities will be presented. The criteria for using drag force or overpressure to represent the blast load on pipes and pressure vessels will be detailed.
Innovative methods for retrofitting the existing structures, which are vulnerable to blast loading, will be described. The strengthening approaches at both foundation level and structure level will be explained.

Fire analysis procedures for determining characteristics of different types of fire, such as pool fire, jet fire, and flash fire will be discussed. Subsequently, the methods for predicting the reduction in structural capacity of steel structures exposed to fire will be explained. Also, the approaches for protecting the steel structural members against fire such as utilizing passive fire protection and its optimization will be outlined.

Numerical simulation of heat transfer by convection, conduction and radiation will be explained in conjunction with its application in predicting the temperature rise inside a shelter building engulfed by an external fire. Further, the impact of radiation on human body and human response criteria to temperature rise inside the building will be presented.

Who Should Attend?
All practicing structural engineers, technical safety engineers involved in design and assessment of onshore and offshore oil & gas structures and similar.
Our Distance Learning Program allows individuals in a university academic program to participate in university courses. These courses follow the syllabus outline with all other students, completing homework, taking quizzes and exams, and projects as applicable. In order to receive a certificate for these courses, participants must complete all work and receive a ‘C’ or better on graded work. These courses follow the academic calendar and are offered on a semester basis (Fall: August—December; Spring: January—May).

<table>
<thead>
<tr>
<th>COURSES OFFERED VIA DISTANCE LEARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>SENG 422: Fire Protection Engineering</strong></td>
</tr>
<tr>
<td>Fire protection design concepts and considerations for chemical, petrochemical, and hydrocarbon processing facilities. Special attention is given to fire hazard analysis, fire risk assessment, fire protection features, and emergency response. Specific fire protection design considerations are studied for the various types of facilities and processes. Prerequisite: Instructor approval.</td>
</tr>
<tr>
<td>4.2 CEUs</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>SENG 310: Industrial Hygiene Engineering</strong></td>
</tr>
<tr>
<td>Application of scientific and engineering principles in the selection and design of control systems related to chemical, physical, and ergonomic exposures in the process and manufacturing industries, relationships of criteria, analysis and specifications for the assessment and control of occupational related illnesses.</td>
</tr>
<tr>
<td>4.2 CEUs</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>SENG 321: Industrial Safety Engineering</strong></td>
</tr>
<tr>
<td>Concepts of designing, operating, and maintaining optimally safe systems, risk management, economic impact, legislation, performance measurement, and accident investigation and analysis, principles and practices in Industrial Hygiene Engineering, Fire Protection Engineering, and Introduction to Systems Safety Engineering.</td>
</tr>
<tr>
<td>4.2 CEUs</td>
</tr>
</tbody>
</table>
Concepts of risk and risk assessment, which uses all available information to provide a foundation for risk-informed and cost-effective engineering practices. Examples and exercises are drawn from a variety of engineering areas.

Application of system safety analytical techniques to the design process, emphasis on the management of a system safety or product safety program, relationship with other disciplines, such as reliability, maintainability, human factors, and product liability applications.

Applications of engineering principles to process safety and hazards analysis, mitigation, and prevention, with special emphasis on the chemical process industries, including source modeling for leakage rates, dispersion analysis, relief valve sizing, fire and explosion damage analysis, hazards identification, risk analysis, and accident investigations.

Following the growth in complexity of engineering systems, demands are increasing for health, safety, and environmental quality with more stringent requirements for reliability and increased engineering performance. This course presents the fundamentals of quantitative risk analysis for cost-effective engineering applications, risk criteria, and risk decisions.

Concepts of risk and risk assessment, which uses all available information to provide a foundation for risk-informed and cost-effective engineering practices. Examples and exercises are drawn from a variety of engineering areas.

Application of system safety analytical techniques to the design process, emphasis on the management of a system safety or product safety program, relationship with other disciplines, such as reliability, maintainability, human factors, and product liability applications.
REGISTRATION

Register Online:
To register online go to: http://psc.tamu.edu/education/continuing-education

When on the Schedule of Classes and Registration page, select from the list of courses offered and choose Register for this course. You will be linked to a secure site allowing you to register and pay for the course online. You will receive a confirmation email upon completing your registration.

Register by Phone:
Call 979-845-3489 and we will take your registration over the phone. Hours are 8 am to 5 pm, CST, Monday through Friday.

Register by Fax:
Fax your registration to 979-458-1493, 24 hours a day, 7 days a week.

Register by Mail:
Mary Kay O’Connor Process Safety Center
Attention: Valerie Green
Texas A&M University
3122 TAMU
College Station, TX 77843-3122

Make checks payable to: Mary Kay O’Connor Process Safety Center

For all other questions contact:
Valerie Green
Associate Director
Email: val-green@tamu.edu
Mary Kay O’Connor Process Safety Center
Continuing Education Registration Form

Last Name
First Name
MI

Company Name
Mailing Address

City
State
Zip Code

Telephone
Fax
Email Address*

COURSE TITLE
COURSE DATE
FEE

CANCELLATION & REFUND POLICY

1) If the course is cancelled for any reason, we will provide a 100% refund or the student can transfer their registration fee to the next offering of the same course, or to a different course.
2) If the student cannot attend the course, they may have a substitute attend.
3) Cancellations must be received ten working days prior to the start of the course to receive a refund. After that time, there will be a 30% penalty. **All** refunds will incur a $25 service charge.
4) The Center will not be responsible for any costs and/or expenses incurred by the registrant when a class is cancelled.

*Email addresses received via this registration form will be added to our email distribution list unless otherwise noted.

REGISTRATION & FEES

To register online go to [http://psc.tamu.edu/education/continuing-education](http://psc.tamu.edu/education/continuing-education) and select courses offered under the Standard Courses section and then you will be linked to the website listing all of our courses. Follow the instructions and be sure to wait for confirmation that your registration was received before exiting the site.

Early registration is 4 weeks prior to the course date. See individual classes for fee (based on course duration).

Circle one: [ ]

Total $ __________________________

Credit Card #: ________________ Exp. Date: __________

Card Holder: ___________________ Security Code: ___

Please send registration form and check (made payable to the Mary Kay O’Connor Process Safety Center) or fax registration if paying by credit card (American Express, Diners Club, MasterCard, or Visa) to:

**Mary Kay O’Connor Process Safety Center**
**Attention: Valerie Green**
**Texas A&M University**
**College Station, TX  77843-3122**
**Phone: (979)845-6884**
**Fax: 979-458-1493**