

# Process Safety Engineering



## PS-4

This course provides an overview of process safety engineering fundamentals for hydrocarbon processing facilities, with emphasis on the upstream oil and gas sector. The focus of this course is on the engineering/design aspects of Process Safety Management. Frequent reference will be made to historical incidents and recurring problem areas. Techniques for analyzing and mitigating process safety hazards applicable to oil and gas processing will also be reviewed. Integration of the concepts covered to achieve a measured approach to Process Safety Engineering is a key aim of this course as well. Exercises and group projects will be utilized to emphasize the key learning points.

### LEVEL – Foundation

### DESIGNED FOR

Facilities, process, and design engineers, as well as new safety/loss prevention engineers who require an overview of Process Safety Engineering.

### YOU WILL LEARN

- Types of equipment and process systems that have historically been problematic in the Upstream and Midstream oil and gas industry
- Basics of risk analysis
- Thinking in terms of Inherently Safer Design
- Most common process hazard analysis methods and where they are used
- Layers of Protection concept - what the different layers are and how they are applied
- Detection and mitigation methods for different types of hazards

### COURSE CONTENT

- Historical incidents and problem areas
- Risk analysis basics
- Process hazards analysis techniques - overview
- Layers of protection
- Inherently safer design
- Hazards associated with process fluids
- Leakage and dispersion of hydrocarbon releases
- Combustion behavior of hydrocarbons
- Sources of ignition
- Hazards associated with specific plant systems
- Plant layout and equipment spacing
- Pressure relief and disposal systems
- Corrosion and materials selection
- Process monitoring and control
- Safety instrumented systems
- Fire protection principles
- Explosion protection



## Daily Agenda

Daily schedule is approximate

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<b>DAY 1</b>	<p><b>Section 1 - Course Introduction</b></p> <p><b>Section 2 - Risk Analysis Basics</b></p> <ul style="list-style-type: none"> <li>• Definition of risk</li> <li>• Tolerable risk criteria</li> <li>• ALARP</li> <li>• Risk analysis method</li> </ul>	<p><b>Section 3 - Inherently Safer Design</b></p> <ul style="list-style-type: none"> <li>• Definition of Inherently Safer Design (ISD)</li> <li>• ISD strategies</li> <li>• Application of ISD to upstream oil and gas facilities</li> </ul> <p><b>Section 4 - Process Hazards Analysis Techniques</b></p> <ul style="list-style-type: none"> <li>• Purpose of PHA's</li> <li>• PHA techniques and their applications</li> <li>• PHA revalidation requirements</li> </ul>
<b>DAY 2</b>	<p><b>Section 4 - Process Hazards Analysis Techniques, continued</b></p> <p><b>Section 5 - Layer of Protection Analysis (LOPA)</b></p> <ul style="list-style-type: none"> <li>• What is LOPA?</li> <li>• The layers of protection concept</li> <li>• Independent protection layers</li> <li>• LOPA methodology</li> </ul> <p><b>Section 6 - Historical Incident Databases</b></p> <ul style="list-style-type: none"> <li>• What is a Historical Incident Database (HID)?</li> <li>• How are HID's useful?</li> </ul>	<ul style="list-style-type: none"> <li>• Incident frequencies</li> <li>• Onshore and offshore data</li> </ul> <p><b>Section 7 - Leakage and Dispersion</b></p> <ul style="list-style-type: none"> <li>• Behavior of different materials upon release</li> <li>• Quantification of gas and liquid release rates</li> <li>• Estimation of vapor cloud size</li> <li>• Dispersion calculations, e.g. toxic (H<sub>2</sub>S) or hydrocarbon gas</li> <li>• Probit functions</li> </ul>
<b>DAY 3</b>	<p><b>Section 7 - Leakage and Dispersion, continued</b></p> <p><b>Section 8 - Combustion Behavior of Hydrocarbons</b></p> <ul style="list-style-type: none"> <li>• The fire triangle</li> <li>• Combustion properties</li> <li>• Characteristics of different types of fires</li> <li>• Thermal radiation calculations and effects</li> <li>• Vapor cloud explosions</li> </ul> <p><b>Section 9 - Sources of Ignition</b></p> <ul style="list-style-type: none"> <li>• Ignition characteristics of different fuels</li> </ul>	<ul style="list-style-type: none"> <li>• Most common causes of ignition – onshore and offshore</li> <li>• Ignition source control options</li> </ul> <p><b>Section 10 - Specific Plant Systems and Equipment</b></p> <ul style="list-style-type: none"> <li>• More detailed look at equipment types most often involved in leak/fire/explosion incidents</li> <li>• Piping systems</li> <li>• Storage facilities</li> <li>• Pumps</li> <li>• Fire Heaters, etc.</li> </ul>
<b>DAY 4</b>	<p><b>Section 10 - Specific Plant Systems and Equipment, continued</b></p> <p><b>Section 11 - Layout and Spacing</b></p> <ul style="list-style-type: none"> <li>• General criteria</li> <li>• Typical site layout methodology</li> <li>• Hazard assessment in plant layout</li> <li>• Spacing guidelines</li> </ul>	<p><b>Section 12 - Pressure Relief and Flare Systems</b></p> <ul style="list-style-type: none"> <li>• Causes of overpressure</li> <li>• Overpressure protection options</li> <li>• Pressure relief valves – types and applications</li> <li>• Relief valve sizing</li> <li>• Flare systems</li> <li>• Thermal radiation from flares and effects</li> <li>• Flare gas recovery systems</li> </ul>
<b>DAY 5</b>	<p><b>Section 14 - Process Monitoring and Control</b></p> <ul style="list-style-type: none"> <li>• One of the first layers of protection</li> <li>• Most commonly controlled process variables</li> <li>• Basic control methods</li> <li>• Understanding the main objectives of process control</li> <li>• Alarm and shutdown settings</li> </ul> <p><b>Section 15 - Safety Instrumented Systems</b></p> <ul style="list-style-type: none"> <li>• Definitions</li> <li>• SIS components</li> <li>• SIF examples – including High Integrity Pressure Protection Systems</li> <li>• SIL assessment methods</li> </ul>	<p><b>Section 16 - Fire and Explosion Protection</b></p> <ul style="list-style-type: none"> <li>• Basic fire protection strategies</li> <li>• Fireproofing</li> <li>• Fire and blast walls</li> <li>• Fire and gas detection systems</li> <li>• Firewater systems</li> <li>• Foam systems</li> </ul> <p><b>Summary and Course Wrap-Up</b></p> <p><b>Section 13 - Corrosion and Materials Selection, is not typically covered in class but is provided as reference material.</b></p>

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