Overview

The course will teach how to analyze, evaluate and control risk for chemical hazards involving acute accidents that impact people. The course would be structured around quantitative methods. The course will include the following:

1. Introduction. (i) Description of acute chemicals hazards, (ii) defining risk, risk vs. safety
2. Brief description of process equipment used to contain, store, control and mitigate the hazards
3. Inherently safe design, facility siting
4. Brief description of some of the famous accidents – Bhopal, Texas City, etc.
5. Hazard identification – go over the structured methods for hazard identification – e.g., HAZOP, FMEA, What If [***Project: do a HazId***]
6. Consequence analysis – (i) how to model fires, explosions, toxic/flammable gas cloud dispersion, (ii) vulnerability modelling – probits, blast effects, (iii) assumptions and simplifications –when and why. Students would actually do calculations.
7. Frequency modelling – (i) initiating event frequency, and probability of failure on demand (PFD) of post-IE events, component probability of failure and failure modes, (ii) event trees and fault trees Brief intro to Bayesian updating methods ????
8. Estimating risk. (i) types of risk analyses: PHA / LOPA using risk matrices, QRA (ii) QRA risk estimation methods: risk contours, FN-curves, individual risk, geographic risk, societal risk, (iii) Estimating risk for fixed and linear risk sources (pipelines, rail lines), (iv) financial risk – safety, loss of production, property damage, reputation, recovery costs, reputation, fines.
9. Evaluating risk. (i) Risk matrices, (ii) Total Risk tolerance criteria, (iii) public vs. workers, (iv) background risks in society and how to develop risk tolerance criteria, (v) how to develop a risk matrix, ensuring it aligns with background risks generally accepted, (vi) ALARP principle, (vii) Land use planning – "MIACC approach"
10. Risk reduction. (i) Justifying ALARP – qualitative via RAGAGEP/best practices or quantitative using Benefit Cost Analysis. (ii) Risk reduction strategies
11. Overall risk management framework, stakeholder engagement, multi-dimensional risk – e.g., crude oil transport by pipelines vs rail cars, net benefit to society of chemicals, regulatory interfaces

Student Population

This course will be offered as a graduate course (1XXX) level. Undergraduate students can take the course, with the permission of the instructor.

Learning Objectives

At the end of the course, the students will be able to:

1). Describe the typical equipment used to contain, control and mitigate hazards
2). Perform a structed Hazard Identification exercise
3). Analyse consequences using standard methods
4). Estimate incident frequencies using probability data and models
5). Estimate risk for various risk sources
6). Evaluate the risk, and develop strategies for risk reduction

Course Description

Course Instructor

Marcello Oliverio

Marcello is a process safety and risk management specialist with over 30 years' experience in the utility (nuclear, gas distribution, propane), oil & gas, chemical, transportation and mining industries. He has leading edge knowledge of the tools, methods and key issues associated with process safety and risk management. He has contributed to, and continues to contribute to national committees and standards development committees focussed on safety and risk. Marcello was a founding member of the Major Industrial Accident Council of Canada, which initiated hazardous materials process safety and risk management in Canada.

Contact Information

OLITECH@ROGERS.COM

Course Materials

For textbooks – two options
(i) Guidelines for Chemical Process Quantitative Risk Analysis, 2nd Edition
CCPS (2nd ed, 2000),
(ii) Crowl & Louvar – Chemical Process Safety – Fundamentals with Applications, 3rd ed. 2011