

Chemical Plant Safety and Risk Assessment - Web course



NP-TEL

NPTEL

<http://nptel.ac.in>

Chemical Engineering

Pre-requisites:

Chemical Process Equipment and Plant Design.

Hyperlinks:

1. S Banerjee, *Industrial Hazard and Plant Safety*, Taylor & Francis, 2003.
2. Daniel A. Crowl, Joseph F. Louvar, *Chemical Process Safety: Fundamentals with Applications* - Prentice Hall, 2002.
3. David.L. Goetsch, "The Safety and Health Handbook" Prentice Hall, 2000.
4. F P Lees, *Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control*, Butterworth-Heinemann, 1996.
5. R.R Fullwood,

COURSE OUTLINE

In the chemical process industry plant safety is important. Knowledge of plant safety is essential to prevent accidents and damages while working in plant.

A safety audit and risk analysis prepares the plant operators and managers to develop a safe protocol and minimize potential damages to process equipments, people and the environment.

This course will give an overview of the safety regulations and practices, plant hazards and their control, risk management principles and techniques and accident analysis.

Contents:

Importance of plant safety and safety regulations, different types of plant hazards and their control, personal protective equipments, principles and procedures of safety audit.

Storage and transportation of chemicals, Risk management principles, Risk assessment techniques (HAZOP, HAZON, Fault Tree Analysis, Consequence Analysis), Onsite and offsite emergency management, Human error Analysis and Accident Analysis.

COURSE DETAIL

A Web course shall contain 40 or more 1 hour lecture equivalents.

Module No	Topic	Lecture Hours
1	Review of Industry Accidents Major Oil Industry Accidents Major Chemical Industry Accidents : Flixborough Disaster, Seveso Disaster, The Mexico LPG Disaster, Mexico Bhopal Disaster, Phillips Disaster.	2

2	<p>Basic Laboratory Safety & Personal Protective Equipments Risk, Hazard, Chemical Hazard Symbols, Incompatible chemicals, Fire Classification; Occupational Health and Safety Administration, The Factories Act, Personal Protective Equipment (PPE).</p>	3
3	<p>Toxic Substance and Confined Spaces Toxic Substances Definition, Classes of Toxicity, Entry Points for Toxic Agents, Effects of Toxic Substance, Relationship of Doses and Responses, Threshold Limiting Values, Exposure Thresholds, Airborne Contaminants, Confined Spaces Hazards, Respiratory Protection, Prevention and Control</p>	3
4	<p>Fire and Explosion Work Place Hazard, Dangerous Substance Fire triangle, Effective Ignition Source, Static Electricity, Explosion: BLEVE, VCE, Detonation and Deflagration, Flammability Limits, LOC, Flash point, Flammability Diagram, Flammable and Combustible Liquids.</p>	4
5	<p>Electrical Safety Hazard Electrical Hazards, Causes of Electrical Shock, Effect of Shocks, Path of Current, Sources of Electrostatic Discharge, Control of Static Electricity, Electrical Grounding; Reducing Electrical Hazards .</p>	2
6	<p>Chemical Process Safety Decomposition & Runaway Reactions, Initiating factors Reactive Chemical Hazard, Case Studies: T2 Laboratories, Florida, Synthron, North Carolina, Phenol-Formaldehyde Reaction. Assessing Reaction Hazard; Tools for evaluating thermal explosion, Steps to Reduce Reactive Hazards. Process Plant Design: Flow Diagrams; Piping and Instrumentation Diagram, Control System, Alarms,</p>	5

Probabilistic Safety and Assessment in the Chemical and Nuclear Industries, Butterworth-Heinemann, 2000.

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Coordinators:

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	Chemical Plant Layout: Passive protection, Active Protection, Emergency Shutdown System, Safety Integrity Level, Inherent Safety Techniques.	
7	Introduction to Nuclear Energy Comparison for Coal vs. Nuclear, Indian Scenario, Three Stage Approach, Nuclear Fuel, Types of Nuclear Reactors, Open/Close Fuel Cycle, Environmental aspects of Nuclear Power.	2
8	Nuclear Safety Major Nuclear Accidents, Objective of Nuclear Safety: Fundamental Nuclear Safety, Radiation Protection, Technical Safety. Analytical Approach to Nuclear Safety: Defense in Depth, Multiple Barriers to Prevent Radioactivity, Design Basis Accident, Beyond Design Basis Events. Design Basis Safety: Fail Safe Philosophy, Redundancy, Diversity and Independency, Two Out of Three Logic. Passive Autocatalytic Recombiner, Facilities to Control and Shutdown a Reactor, Emergency Core Cooling System, Core Catcher. International Nuclear and Radiological Event Scale (INES) Licensing of Nuclear Power Plant: Site Evaluation, Design, Construction, Commissioning, Operation, Decommissioning.	5
9	CANDU Safety Functions and Shutdown Systems Pressurized Heavy Water Reactor, CANDU, Differences in Reactor-Core Design, Refueling, Fuel-Cycle Safety, Shutdown Systems (SDS), Trip System, Safety Functions.	2
10	Fast Breeder Reactor & Sodium-Water Reaction Fuel Arrangement in FBR, Safety Criteria, Liquid Metal Fast Breeder Reactor Safety Features, Passive Shutdown System, Potential Failure Events, Severe Accident Scenarios Sodium Reactivity with Water: Micro,	2

	Small, Intermediate, Large Leak, Leak Detection System, Strong Signal Detection, Rate of Rise Detection, Plant Operator Action Plan Sodium Fire Protection: Design Strategies.	
11	Hazard Identification & Risk Assessment The Process of Risk Management Hazard Identification, Evaluation (Risk Assessment, Risk Matrix), Risk Control Implementation, Action and Recommendation.	2
12	Hazard Evaluation Hazard Evaluation Techniques: Quantitative, Qualitative Safety Review, Process / System Checklists, Dow Fire and Explosion Index, What-If Analysis.	2
13	Hazard and Operability Studies (HAZOP) HAZOP technical approach, Procedure, Analysis Terminology, Guidewords, Parameters. Examples, Advantages, Weakness.	2
14	Probabilistic Hazard Evaluation Reliability, Probability Distribution, Demand and Failure, Fault Tree Analysis (FTA), Minimal Cut Set Identification, Event Tree Analysis.	3
15	Review of Nuclear Accidents Chernobyl Accident, Fukushima Accidents, Lessons Learned.	1