



# An Introduction to Process Safety Management

An Online Continuing Education Course for Engineers

**Course Number: M-2093**

**Credit: 2 Hours / 2 PDH / 2 CPD**

# An Introduction to Process Safety Management

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## Section 1 - Introduction

The purpose of this course is to familiarize the student with the history of how PSM (Process Safety Management) developed, some of the related topics, and a basic understanding. The industry standards call for a person implementing these concepts to be competent. This course will not make anyone "competent" since being competent involves special training, years of applicable experience, and certification. This course will, however, provide an overview.

### Disclaimer:

This course is based on the author's study of the latest release of the applicable standards and other references and is subject to his own interpretation. It is not to be construed as the opinion of OSHA, CSB, ISA, AIChE, IEC, or any other agency. Because situations can vary, and the author has no control over the use of this information, the student is encouraged to study appropriate references and apply them as they deem appropriate. The contents here are chosen by the author for this discussion only for the general education of the reader. Examples are presented as illustrations of the topics discussed in this course for discussion and are not intended to be a guide to the application of these concepts.

## **Section 2 – History, Why it's important**

The processing of different materials into a variety of useful products has improved living conditions for most of the world. Plastics, fertilizers, pesticides, fuels, medicines, etc., have made all of our lives safer, more convenient, and more comfortable. However, some of those materials and processes can be hazardous and can create incidents that harm people or the environment. These incidents, along with many others, have led to public demand for action. Governments around the world have responded with laws requiring an improvement in the safety of process facilities. A deeper study of these incidents shows that most occur as a result of a few simple coincidental mistakes or failures.

The U.S. Chemical Safety and Hazard Investigation Board, commonly known as the Chemical Safety Board or CSB, is an independent Federal Agency that investigates incidents. They are an excellent resource on this subject and are easy to find; just search for CSB.gov in your favorite web browser. The reader is encouraged to visit the site and review the case studies and other information there.

A few notable incidents are:

### **2.1 Flixborough, UK – Nypro UK (1974)**

Nypro UK was a joint venture between Dutch State Mines and British National Coal Board. It produced caprolactam, which was a chemical used to make nylon. Part of the process involved heating cyclohexane and passing it through a series of reactors. One of the reactors developed a leak and was bypassed with a piping modification. It is thought that this piping modification failed, releasing hot cyclohexane, which ignited, causing a massive explosion.



- Nearly the entire production facility was destroyed
- None of the 18 Control Room occupants survived the blast
- In total, 28 employees were killed, and 36 injured
- No fatalities in the surrounding community, but 50 were injured, and an estimated 2000 properties were damaged

## **2.2 Bhopal, India – Union Carbide India Limited (1984)**

Union Carbide India Limited was a joint venture between Union Carbide Corp. and Indian Government-controlled banks. Often called the world's worst industrial disaster, the plant manufactured methyl isocyanate gas (MIC). MIC was eventually used to make Sevin's pesticide. A purported inadvertent introduction of water into a tank of MIC caused a runaway exothermic reaction, resulting in a release of highly toxic gas. The Indian government claimed that poor operating practices and neglected maintenance were the cause of the accident. Union Carbide claimed an act of sabotage was the cause.

# GAS DEATHS IN INDIA EXCEED 1,000, WITH THOUSANDS HURT; GANDHI SEEKS COMPENSATION



AP Wirephoto  
A woman, a victim of the toxic gas that spread through Bhopal, India, comforting a more seriously injured relative at a crowded hospital.

## COMPANY IS PRESSED

Doctors Say 20,000 May Suffer Aftereffects — Acrid Odor Lingers

By Reuters

BHOPAL, India, Dec. 4 — At least 1,000 people were reported to have been killed by poison gas that leaked from an American-owned insecticide plant here Monday. Prime Minister Rajiv Gandhi broke off an election campaign tour to visit the city and said he would seek compensation.

A spokesman for the state government of Madhya Pradesh said the official death toll from the accident, one of the largest industrial accidents in history, had reached 548. But the United News of India said its reporters put the figure at 1,200.

### Hundreds of Burials

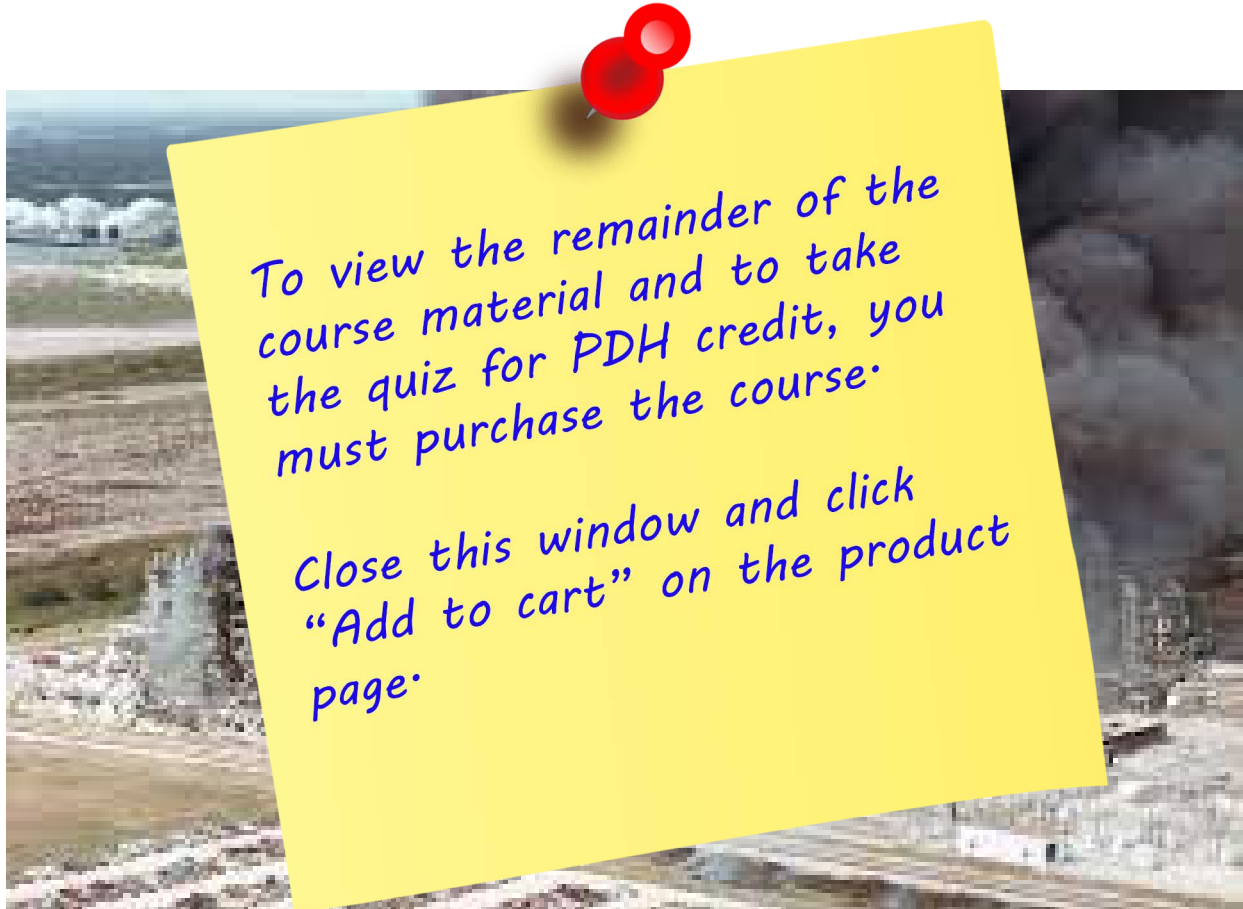
The agency said that 345 victims had been buried at Bhopal's central Sirdaus Manzil graveyard and that 445 had been cremated in an area of the city called Chola Vishram Ghar.

[The Associated Press quoted two doctors as saying that at least 1,000 people had been killed. They were quoted as saying that they counted 500 corpses at the city's major hospitals and had reports of at least 500

- The resulting gas cloud was heavier than air and spread to nearby communities
- While exact data is not available, estimates are that 8000 people died within two weeks of the accident, another 8000 died later, and nearly 600K injured

### 2.3 Pasadena, TX – Phillips Petroleum (1989)

The Phillips Houston Chemical Complex produced High-Density Polyethylene (HDPE) from highly flammable ethylene gas. A relatively simple mistake during a routine maintenance operation on a polyethylene reactor resulted in a release of a vapor cloud, which found an ignition source and exploded. Shortly thereafter, a 20K gallon isobutane tank exploded, followed by several other explosions



- The explosion registered 3.5 on the Richter Scale and scattered debris as far as 6 miles from the site.
- 23 employees were killed, and another 314 injured