

## **Advancing Process Safety Technology and Management Practices**

By  
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I am a retired manufacturing/engineering vice president - 37 years with Union Carbide Corporation, soon to be merged with Dow Chemical Company. In 1984, I was vice president of Carbide's Canadian plastics and chemicals operations and living in Toronto. On December 5, 1984, I was informed that a methy isocyanate release had occurred during the night of December 4 at a Union Carbide plant in Bhopal India. Initially it was reported that there were 10 fatalities. My reaction was one of horror. By the end of the day the total had grown to over 100. The number was all but incomprehensible. As you know, the final count was approximately 3000. To put this into perspective, it exceeded the total battlefield fatalities suffered by the U.S. Marines in the World War II battle for Guadalcanal. The response by Union Carbide and the chemical industry both in the U.S. and worldwide was far-reaching, and the Bhopal incident remains a touchstone for process safety sixteen years later.

The Center for Chemical Process Safety (CCPS) was founded in 1985 shortly after the Bhopal incident and now consists of 80 sponsoring members. CCPS is an industry-driven, non-profit professional organization affiliated with the American Institute of Chemical Engineers (AIChE). It is committed to developing engineering and management practices to prevent or mitigate the consequences of catastrophic events involving the release of chemicals and hydrocarbons that could harm employees, the community, and the environment. Areas of interest to CCPS sponsors are hazard and risk analysis, engineering design, operations and maintenance, information dissemination, and process safety management. Sponsoring members of CCPS include major petroleum, chemical, and pharmaceutical companies as well as other manufacturers and users of chemicals, engineering contractors, safety consultants, insurance firms, and government agencies, including the U.S. Department of Energy (DOE).

To fulfill our charter of improving safety in the manufacture and handling of chemicals, we've set these goals:

- Establish and publish the latest scientific and engineering practices for prevention and mitigation of incidents involving toxic and/or reactive materials.
- Encourage the use of such information by dissemination through publications, seminars, symposia and continuing education programs for engineers.
- Advance the state-of-the-art in engineering practices through research in prevention and mitigation of catastrophic events.
- Develop and encourage the use of undergraduate education curricula which will improve the safety knowledge and consciousness of engineers.

In 1988, CCPS outlined a comprehensive process safety management (PSM) system comprised of twelve essential and inter-related tasks, which have been developed and enhanced in subsequent years. These twelve elements, briefly described in the following

paragraphs, are based on the premise that process safety management is integral to the overall management work of the enterprise. It must be led by committed senior management and that management must have knowledge of and hands-on involvement in the work. A staff-driven effort will fail.

### **Accountability: Objectives and Goals**

A system for accountability institutionalizes every employee's (from plant manager to hourly personnel) obligation to explain and answer for one's actions that are related to company expectations, objectives, and goals. Because it is associated with positive and negative rewards for actions taken, accountability gives "teeth" to the roles and responsibilities assigned through the management system.

### **Process Knowledge and Documentation**

A system for process knowledge and documentation maintains up-to-date documentation for the life of a process. The information may be kept and protected in hard copy form or in electronic form, but it must be accessible to employees who need it in performing their safety-related duties within a plant's PSM system. This information represents the plant's institutional memory concerning the hazards, technology, equipment, processes, and decisions that are made to manage the risk of plant operations.

### **Capital Project Hazard Reviews**

A system for performing qualitative hazard reviews from process inception until process deployment. This system interacts with a company's project management system to communicate identified hazards and suggested improvements to process development/design teams. Plans are developed for hazard reviews at appropriate times throughout the development/design phase of the process until process deployment.

### **Process Risk Management**

A system for evaluating the risk of operating processes using qualitative or quantitative risk analysis techniques. This system interacts with the management of change system and project management system to communicate identified hazards and suggested improvements to facility management. Plans are developed for risk evaluations at appropriate times through the operating lifetime of the process until decommissioning.

### **Training and Performance**

A system to develop procedures and to train plant personnel on the operation, maintenance, and emergency actions associated with plant processes. The system should provide for initial and refresher training at appropriate intervals; training documentation should be developed and maintained.

### **Human Factors**

A system to ensure that human factors issues have been addressed in all relevant PSM activities. This system ensures that human factors reviews of process design/operations are conducted at appropriate times during the lifetime of the process.

**Management of Change**

A system for preventing the introduction of new hazards or an unknown increase in the risk associated with existing hazards resulting from modifications to plant operations. Establishes a formal, documented authorization process for all changes that are not replacements-in-kind.

**Process and Equipment Integrity**

A system to ensure that equipment, systems, structures, and components are maintained in a fit-for-duty manner that does not increase the risk associated with process operation. A system to schedule, perform, and document preventive maintenance, inspections, and tests on critical equipment. A system to resolve equipment deficiencies as soon as possible in a way that minimizes risk.

**Company Standards, Codes, and Laws**

A system to develop, acquire, evaluate, disseminate, and maintain an archive of standards, codes, and laws that affect process safety. This system creates and maintains company standards. It keeps this information up-to-date and makes it accessible to potential users.

**Incident Investigation**

A system for scheduling, staffing, performing, and documenting investigations of process safety incidents and near-misses. A system for managing the resolution of findings and corrective actions generated by the investigations.

**Audits and Corrective Actions**

A system for scheduling, staffing, performing, and documenting audits of process safety management systems and operating processes. A system for managing the resolution of findings and corrective actions generated by the audits.

**Enhancement of Process Safety Knowledge**

A system to proactively seek out new process knowledge and documentation from internal and external sources. Most existing PSM structures do not include increasing process safety knowledge as an explicit element.