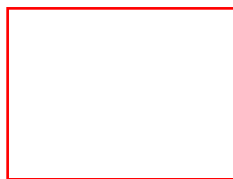


[To Mary Kay O'Connor Process Safety Center Home Page](#)

[To Program details for Day 1](#)

[To Program details for Day 2](#)



**Mary Kay O'Connor Process Safety Center:  
Research Program, Current Activities, and Future Direction**

**Dr. Sam Mannan, PE, CSP  
Director, Mary Kay O'Connor Process Safety Center  
Texas A&M University System  
College Station, Texas 77843-3122**

---

Paper presented at the 1st Annual Symposium of the Mary Kay O'Connor Process Safety Center, "Beyond Regulatory Compliance, Making Safety Second Nature",  
George Bush Presidential Conference Center, College Station, Texas  
March 30-31, 1998.

---

**ABSTRACT**

The Mary Kay O'Connor Process Safety Center was established to produce engineers and practitioners trained in process safety; to provide its members and others with the research base needed to compete successfully in the rapidly growing chemical processing industry, and to provide an independent process safety resource for academia, government, and the world-wide chemical processing industries. One of the goals of the Center is to be a catalyst for the process industry to develop and maintain the culture to where safety is second nature in all activities and operations. This safety awareness culture can be accomplished gradually by the research, education, service, and training programs of the Center. In addition, changes in the engineering curriculum are required not only to offer process safety engineering and safety courses as separate and focused courses, but also to integrate process safety into the curriculum of other core courses such as thermodynamics, transport phenomena, heat transfer, etc. Finally, graduate research projects at the Master's and Ph.D. level where the thesis/dissertation is focused on solving process safety-related problems is critical to the advancement and understanding of process safety problems and issues.

The focus of this presentation is the planned programs and activities of the Mary Kay O'Connor Process Safety Center and how these programs and activities will accomplish the overall goals and mission of the Center.

---

# ***Mary Kay O'Connor Process Safety Center:***

## ***Current Activities and Future Direction***

---

***Dr. Sam Mannan, PE, CSP***  
***Director and Associate Professor***  
***Mary Kay O'Connor Process Safety Center***  
***Texas A&M University System***  
***College Station, Texas 77843-3122***

### ***REASONS FOR INCREASED AWARENESS AND CONCERN ABOUT HAZARDOUS MATERIAL RELEASES***

#### ***Highly Publicized Accidents***

- Bhopal, India***
- Mexico City, Mexico***
- Three-Mile Island (Nuclear) -Chernobyl (Nuclear)***
- Phillips Petroleum (Pasadena, TX) -Arco***
- Shell Refinery (Norco, LA)***
- Exxon Refinery (Baton Rouge, Louisiana)***

#### ***Increasing Number and Size of Facilities***

#### ***Government and Industry Regulations and Recommended Practices***

- OSHA***
- EPA***
- API***
- AICHE***

### ***CHALLENGES AND OPPORTUNITIES***

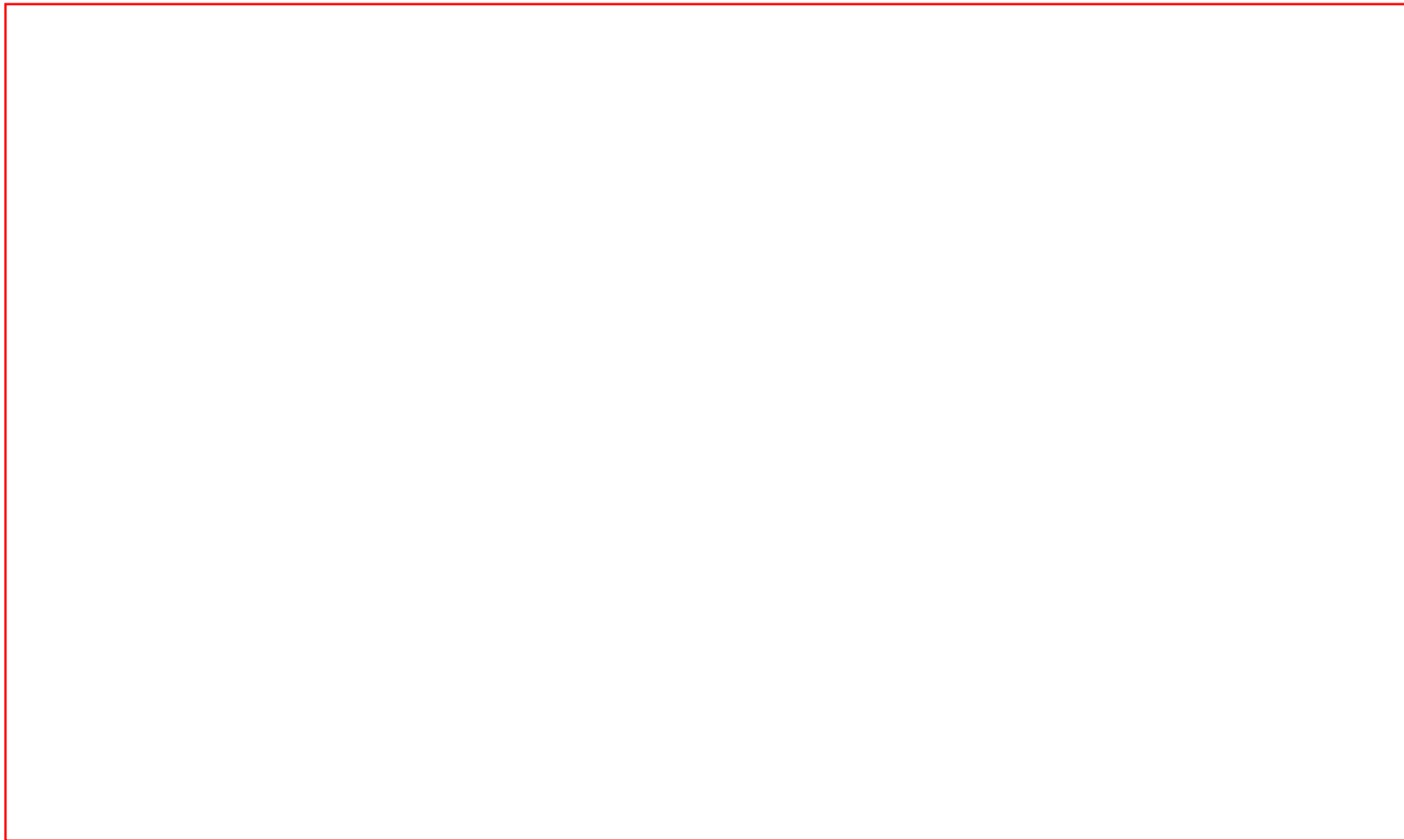
- Design flaws, wrong equipment specifications, and lack of or disregard of operating and maintenance procedures***
- Perspective varies***
- Safety is of primary importance and is critical to the industry's continuing "license to operate."***

## ***SHELL LETTER***

### ***BACKGROUND***

- *Impact of laws and regulations*
- *Regulations address only those things for which we have knowledge and understanding*
- *Example: OSHA process safety management regulations require facilities to develop and implement management of change procedures*

### ***MANAGEMENT OF CHANGE FOR A GLASS-LINED REACTOR***



### ***OTHER ISSUES***

***\$ Inherent safety in process design***

- *Equipment selection*
- *Operating and maintenance procedures*
- *Understanding of the underlying science and application of those principles*

## **EXAMPLE**

- *high Polyethylene plant - large quantity of flammables at very pressures and temperatures*
- *Inherent hazard - any accident has the potential of releasing large quantities of the flammable which because of the thermodynamics can likely flash and form an aerosol*
- *After the fact, "bells and whistles" can be added to make the process extrinsically safer*
- *Intrinsically safer process during the design and construction phase*

## **WHAT CAN WE DO?**

- *Create culture: Safety is second nature irrespective of regulatory requirement/climate*
- *Driven by a total understanding of the underlying engineering, process chemistry, and other factors*
- *Universities must play a significant role in addressing this challenge*
- *Integrated curriculum*
- *Mary Kay O'Connor Process Safety Center*

## **THE INTEGRATED APPROACH**

- *Recognize that process safety should be integrated into a comprehensive instruction and research program*
- *Process design courses*
- *Chemical reaction engineering*
- *Thermodynamics*
- *Specific process safety engineering courses*
- *Research*

## **MISSION, VISION, AND GOALS**

*Mission -- improve safety in the chemical process industry.*

***Vision -- be an international leader in developing safer processes, equipment, procedures, and management strategies that will minimize losses within the processing industry***

***Goals -- General***

***Education***

***Information storage, retrieval, and analysis***

***Service***

***Research***

## ***GENERAL GOALS***

- ***Marshall all the resources of the university (Solve complex problems which require multidisciplinary teams)***
- ***Develop capability to respond quickly and effectively to the research needs of other organizations***
- ***Attract outstanding faculty, researchers, practitioners, and students***
- ***Sponsor or participate in safety-related events such as symposia and design contests***
- ***Serve as a role model in good safety practices for other institutions and within the University***

## ***GENERAL GOALS: FUTURE***

- ***Irrevocable paradigm shift***
- ***Produce several chemical engineering Ph.D.s per year with specialization in process safety engineering***
- ***Research and outreach***

## ***EDUCATION***

- ***Three-pronged approach***
- ***Undergraduate and graduate courses dedicated specifically to process safety engineering***
- ***Incorporate process safety problems into existing courses, such as design, reaction kinetics, and thermodynamics***
- ***Sponsor training of engineering faculty through participation in continuing education short courses covering process safety***

## ***EDUCATION - GOALS***

- *Improve knowledge and awareness of process hazards and safety for faculty, students, engineers and other professionals, plant workers, public safety personnel, transportation workers, and the public*
- *Develop state of the art educational tools, undergraduate and graduate courses, and continuing education programs*
- *Produce engineers with a good education in safety*

## ***EDUCATION - CURRENT ACTIVITIES***

- *An interdisciplinary, elective course in Process Safety Engineering*
- *Graduate counterpart*
- *Use of SACHE modules within traditional chemical engineering courses*
- *Increase faculty awareness*

## ***CONTINUING EDUCATION***

- *Continuing education courses to practitioners in industry*
- *Intent is to provide training at outreach locations in a flexible format*
- *Structured series of courses*

## ***EDUCATION - FUTURE***

- *Several multidisciplinary advanced level courses on process safety and associated technologies offered at multiple campuses*
- *Continuing education program - ultimate objective is to move from the current campus-oriented offerings to an interactive distance-learning system*
- *Degree programs*

## ***DEGREE PROGRAMS***

*M.S. and Ph.D. graduates in chemical engineering*

*The degree programs for these graduates will include the following features:*

- *Traditional core chemical engineering courses.*
- *Additional process safety-specific courses.*
- *M.S. or Ph.D. theses addressing the solution of an engineering problem*

*related to process safety.*

## ***INFORMATION STORAGE, RETRIEVAL, AND ANALYSIS***

### ***THE CHALLENGE***

- *Information does not exist*
- *Accuracy and credibility are questionable*
- *Not well organized or easily accessible*

## ***INFORMATION STORAGE, RETRIEVAL, AND ANALYSIS***

### ***GOALS***

- *Gather and store information related to chemical process safety including case histories, equipment and human reliability*
- *Develop computer databases and user interfaces to provide easy access to and analysis of this information*
- *Analyze this information and publicize the results.*

## ***INFORMATION STORAGE, RETRIEVAL, AND ANALYSIS***

### ***CURRENT ACTIVITIES***

- *Library and information resources*
- *Newsletter: Centerline*
- *Website (<http://process-safety.tamu.edu/>)*

## ***INFORMATION STORAGE, RETRIEVAL, AND ANALYSIS***

### ***FUTURE PLANS***

- *Development of computer databases and user interfaces to provide easy access and analysis of process safety-related information*
- *Web-based training*
- *Process Safety Newsgroup*
- *Comprehensive accident databases*
- *Dissemination of information: Electronic/Web, monographs, research papers, and guidelines*

## ***SERVICE***

- *Mission of a university and its faculty*
- *Changing nature of the chemical engineering profession*
- *Accident from a small facility compared to an accident in a plant operated by a large multinational company*

## ***SERVICE - GOALS***

- *Provide service to small and medium enterprises, government agencies, institutions, Local Emergency Planning Committees, and others to evaluate and minimize risk*
- *Provide independent accident investigation and analysis services to industry and government agencies, particularly for those accidents that suggest new phenomena or complex technologies*

## ***SERVICE - FUTURE PLANS***

- *Seek collaborative efforts with government agencies (both state and federal), professional and trade organizations, and industry*
- *Accident investigation*

## ***ACCIDENT INVESTIGATION***

- *Multiple accidents that exhibit common phenomena*
- *Any accident that suggests new phenomena related to basic research or fundamental issues*
- *Independent third party evaluation, peer review, or critique of accident investigations conducted by government agencies*
- *Research accident investigation techniques and issue research reports providing recommendations for the best possible technique for accident investigation*
- *Development of software and tools for accident investigation*

## ***RESEARCH - GOALS***

- *Systematically identify the greatest risk in terms of severity of consequences and probability of occurrence and prioritize*
- *Systematically identify those projects that could be undertaken by the*



*Center and would most effectively address the risks identified by risk analysis*

- *Develop inherently safer process schemes for the most common and most hazardous processes; develop engineering design concepts for developing and implementing such processes*
- *Develop devices, systems, and other means for improving safety of chemical operations, storage, transportation, and use by prevention or mitigation*
- *Improve means for predicting and analyzing the behavior of hazardous chemicals and the systems associated with them*

## **RESEARCH - CURRENT ACTIVITIES**

- *Reactive Systems Research and Teaching Laboratory*
- *Two-Phase Viscous Flow Through Safety Relief Valves*
- *Post-Release Transport and Fate of Toxic Chemicals and Their Mixtures*
- *Accident database analysis*

## **RESEARCH - FUTURE PLANS**

- *State-of-the-art reactive chemicals laboratory*

*APTAC for reactive screening of chemical reaction compounds and mixtures*

*For thermal analysis of solid or liquid chemicals or for gas/liquid, liquid/liquid, gas/solid, and liquid/solid mixtures*

*Time-dependent kinetic data and temperature and pressure profiles for both open and closed systems*

*It can also be used for process simulation of batch and semi-batch reactions, fire exposures, emergency relief venting, and physical properties measurement*

## **IDENTIFYING PROBLEMS AND MULTIDISCIPLINARY APPROACH**

- *Highly qualified team of experts who have international reputations*

***Identification of problems:***

- Input from the industry***
- Annual symposium***

***OPERATIONS DIAGRAM***

***CONCLUSIONS***

- Paradigm shift in chemical engineering curriculum***
- Comprehensive exposure to***

***core chemical engineering courses integrated with process safety problems***

***limited number of specific process safety engineering courses***

- M.S. and Ph.D. graduates whose degree programs are focused on process safety engineering problems***
- Research should help industry in a practical and immediate manner - seek adequate input from industry as well as others***
- Proactive programs both by the industry as well as the universities***

***ACKNOWLEDGEMENTS***

- TEXAS A&M UNIVERSITY***
- TEXAS ENGINEERING EXPERIMENT STATION***
- CHEMICAL ENGINEERING FACULTY***
- T. MICHAEL O'CONNOR***

[To Mary Kay O'Connor Process Safety Center Home Page](#)

[To Program details for Day 1](#)

[To Program details for Day 2](#)