MARY KAY O'CONNOR PROCESS SAFETY CENTER
TEXAS A&M ENGINEERING EXPERIMENT STATION

Short Course On

RECENT DEVELOPMENTS IN PROCESS SAFETY

Presented by Mary Kay O'Connor Process Safety Center
Dr. M. Sam Mannan, PE, CSP, DHC

Bangladesh University of Engineering and Technology
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RECENT DEVELOPMENTS IN PROCESS SAFETY

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Program Content:

Process safety is a relatively new discipline that is gradually gaining more and more significance driven by recent events, public pressures, risk perception, and sustainability issues. This course covers the evolution of process safety, development and implementation of various regulations worldwide and the performance-based nature of process safety. Recent developments resulting from various drivers are also discussed in detail.

During the 80's and 90's a number of catastrophic events led to the promulgation of regulations and standards with regard to process safety. Prior to these programs, process safety was mostly practiced on an *ad hoc* basis depending on company culture and business objectives. Two new areas that have received a lot of attention starting the late 1990's are inherent safety and reactive chemicals.

Inherent safety has been recognized as a design approach useful to remove or reduce hazards at the source instead of controlling them with add-on protective barriers. It is widely accepted as a good engineering practice. However, inherent safety is based on qualitative principles that cannot easily be evaluated and analyzed, and this is one of the major difficulties for the systematic application and quantification of inherent safety in plant design. During the last few years, several measurement techniques and analysis tools have been developed to estimate the degree of inherent safety of a plant or a process unit. A more ambitious goal of inherent safety programs is to break the traditional boundaries of safety ideology associated with the idea that safety is subjective and hence non-quantifiable.

The principle of inherently safer design is the cheapest if applied at the early stage of process development and design. The integration of safety into process design and optimization is highly desired. This course discusses procedures for integrating safety into design and optimization framework.

Process safety has been emphasized in the petroleum refining and petrochemical industry over the decades. This is especially true in the refinery unit processes, where reactive and hazardous materials are handled at elevated temperatures and pressures. The guiding

principles of inherent safety have been clearly illustrated by Trevor Kletz. While there is no argument against the concepts of inherent safety principles, the application of these principles often gives rise to a discussion of overall risk.

Another recent area of interest in process safety is reactive chemicals. This course also includes a structured approach for the evaluation of reactive chemical hazards that integrates literature data screening, computational estimations, theoretical modeling, and experimental measurements. The main goal of this systematic approach is to focus the analysis on the most likely and most hazardous reaction stoichiometry and hence reduce the need for detailed experimental analysis for a large number of process reactions. More detailed and advanced experimental analyses may be required for the more complex and reactive systems.

Other recent developments presented in this course include:

- the development and implementation of facility siting standards, fatigue standards, metrics and performance measurements standards following the BP Texas City incident,
- the development and implementation of chemical security procedures and technology following the 9/11 events,
- the development of new issues and programs following offshore incidents particularly the Macondo Gulf incident in the USA,
- the development of linkage of process safety with sustainability issues, and
- the growing debate on risk perception issues and the role played by society in such issues.

It is the purpose of this course to share recent developments in process safety and to present and discuss examples of dealing with and adjusting to the ever-changing requirements and objectives. During the whole course, a number of case histories are used to illustrate the course topics.

Who Should Attend?

This course is primarily designed to meet the needs of all personnel involved in every level of onshore and offshore process operations, production, design, maintenance as well as members of the Health & Safety & Environment department.

Biography

Dr. M. Sam Mannan is Regents Professor in the Chemical Engineering Department at Texas A&M University and Executive Director of the Mary Kay O'Connor Process Safety Center at the Texas Engineering Experiment Station. The mission of the Center is to improve safety in the chemical process industry by conducting programs and research activities that promote safety as second nature for all plant personnel in their day-to-day activities. Before joining Texas A&M University, Dr. Mannan was Vice President at RMT, Inc., a nationwide engineering services company.

Dr. Mannan is a registered professional engineer in the states of Texas and Louisiana, a Certified Safety Professional, and a Professional Process Safety Engineer. His experience is wide ranging, covering process design of chemical plants and refineries, computer simulation of engineering problems, mathematical modeling, process safety, risk assessment, inherently safer design, critical infrastructure vulnerability assessment, aerosol modeling, and reactive and energetic materials assessments.

Dr. Mannan is involved very closely with projects that include hazard assessment and risk analysis, process hazard identification, HAZOP (hazard and operability) studies, vulnerability assessment, process safety management, and risk management. His research interests include development of inherently safer processes, application of computational fluid dynamics to study the explosive characteristics of flammable gases, development of quantitative methods to determine incompatibility among various chemicals, application of calorimetric methods for the assessment of reactive hazards, and the application of consequence analyses to assess the impact of process plant incidents. He co-authored the ***Guidelines for Safe Process Operations and Maintenance*** published by the Center for Chemical Process Safety, American Institute of Chemical Engineers. He is the editor of the 3rd and 4th edition of the 3-volume authoritative reference for process safety and loss prevention, **Lees' Loss Prevention in the Process Industries**. Dr. Mannan has published 235 peer-reviewed journal publications, 4 books, 8 book chapters, 207 proceedings papers, 14 major reports, and 240 technical meeting presentations.

Dr. Mannan is the recipient of numerous awards and recognitions including the American Institute of Chemical Engineers ***Service to Society Award***, the Texas A&M University Association of Former Students' ***Distinguished Achievement Award for Teaching***, the Texas Engineering Experiment Station ***Research Fellow***, the Texas A&M University Dwight Look College of Engineering ***George Armistead, Jr. '23 Fellow***. In 2003, Dr. Mannan served as a ***consultant to Columbia Accident Investigation Board***. In 2006, he was named the inaugural holder of the T. Michael O'Connor Chair I. In 2007, he was elected Fellow of the American Institute of Chemical Engineers. In December 2008, the Board of Regents of Texas A&M University System recognized Dr. Mannan'sexemplary contributions to the university, agency, and to the people of Texas in teaching, research and service by naming him Regents Professor of Chemical Engineering. Dr. Mannan is a Guest Professor at the Nanjing University of Technology and the China University of Petroleum in Qing Dao. In September 2011, the Technical University of Łódź, Poland, conferred the ***Doctoris Honoris Causa*** on Dr. Mannan. In 2012, Dr. Mannan was awarded the Bush Excellence Award for Faculty in Public Service. In March 2013, Dr. Mannan was named a Distinguished Honorary Professor at the Rajiv Gandhi Institute of Petroleum Technology. In 2015, Dr. Mannan was elected Fellow of the Institute of Chemical Engineers, UK.

Dr. Mannan received his B.S. in chemical engineering from Bangladesh University of Engineering and Technology (BUET) in Dhaka, Bangladesh in 1978, and obtained his M.S. in 1983 and Ph.D. in 1986 in chemical engineering from the University of Oklahoma.