

## Mary Kay O'Connor Process Safety Center

Chemical Engineering  
Division of the  
Texas Engineering  
Experiment Station  
  
The Texas A&M  
University System

# Centerline

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## 2011 International Symposium, October 25-27 Keynote Speakers Announced

The *2011 International Symposium* of the Mary Kay O'Connor Process Safety Center will be held at the College Station Hilton Conference Center on **October 25-27, 2011**. Keynote speakers slated for the event will be **The Honorable Lee H. Hamilton**, who will speak on October 25 and **Professor Edward J. Calabrese** who will give his talk on October 26. *See page 8.*



*Calabrese*



*Hamilton*

## Mannan Featured on CBS National News

**Sam Mannan** was recently featured in a CBS national news story for his research involving developing a national system of state-based surveillance measures in order to more effectively prevent and mitigate the consequences of hazardous substance-related incidents. *See page 9.*



## MKOPSC Faculty Fellows Receives Honors

MKOPSC Faculty Fellow **Carl Laird**, assistant professor in the Artie McFerrin Department of Chemical Engineering, has been appointed holder of the William and Ruth Neely Faculty Fellowship in Chemical Engineering, and he has been named recipient of the prestigious *Wilkinson Prize* for Numerical Software.

MKOPSC Faculty Fellow **Mahmoud El-Halwagi**, professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, has been named recipient of the *Faculty of the Year Award* by American Institute of Chemical Engineers (AIChE), appointed to serve on the inaugural advisory board of the Center for Energy Initiatives, launched by AIChE, appointed national chair for the AIChE Computing and Systems Technology (CAST) Division as well as appointed an academic trustee for the Computer Aids for Chemical Engineering (CACHE) Corp. *See pages 13-14.*



# Directors Corner

There have been a few occasions this year that have caused me to pause and reflect on our knowledge of process safety issues and implementation of process safety. Each of these occasions forced me to look at society's perception of risk and how risk is managed. Below, I will briefly discuss and reflect upon these experiences.

## ***Congressional Hearing - CFATS Reauthorization***

Because of Center's track record of research and work regarding Inherent Safety (IS) issues, in February 2011, I was invited to appear before the US Congress to provide testimony on the reauthorization of the Chemical Facility Anti-Terrorism Standards (CFATS). Specifically, I discussed the role and inclusion of IS requirements within the Department of Homeland Security's CFATS legislation. As can be seen from the testimony, there are still a lot of misconceptions about IS implementation at existing facilities. I continue to believe that science has not developed to the extent where inherent safety can be quantified. While it is possible that sometime in the future, inherently safer options may become part of legislation and/or regulation, we as a society must remember that such options must not create unintended consequences. One way to ensure this is to require risk assessments whenever IS options are considered. In fact, as I have testified,

whenever IS options are considered or implemented, facilities must show that:

- Overall risk has decreased,
- Unintended consequences have not been created,
- Risk has not been transferred or accumulated elsewhere, and
- Implementation of the IS options does not result in departure of industry from one area to another.

For a complete version of my oral testimony, please see: [http://pscfiles.tamu.edu/posts/testimony\\_02112011.wmv](http://pscfiles.tamu.edu/posts/testimony_02112011.wmv)

## ***Bayer CropScience***

Another event I had the opportunity to participate in was a lawsuit brought on by a group of community members from Institute, West Virginia, against Bayer CropScience. This Bayer facility produced and used methyl isocyanate (MIC) for producing a pesticide called TEMIK. In August 2008, an incident that resulted in two fatalities and other consequences occurred. It is worth noting that MIC was not involved in that incident. Following the August 2008 incident, Bayer made several significant changes to that plant, including reducing the MIC storage from 200,000 lbs. to 50,000 lbs. The MIC storage also was moved completely underground and the plant was redesigned to include several layers of protection. As the plant was getting ready to start up production again, the

lawsuit was filed in Federal Court pleading for an injunction to prohibit startup of the plant because the plaintiffs believed the plant posed an unreasonable risk to the public. The federal judge granted a temporary injunction and subsequently, the judge issued an order appointing me as the court-appointed expert to help adjudicate the matter. I, along with assistance from my team, conducted extensive inspections, document reviews, and interviews of appropriate plant personnel. I then filed an extensive report to the court elaborating on my conclusions and findings. With regard to the risk of a catastrophic event involving MIC, I had calculated it to be  $10^{-14}$ .

While court proceedings were ongoing, including unsuccessful efforts by plaintiff lawyers to disqualify me, Bayer AG (corporate offices in Germany) made a business decision. In a prior agreement with the EPA, Bayer had already agreed to phase out the production of TEMIK by the end of 2012. The factors I believe that led to this decision were as follows. Bayer still did not know when the case in front of the federal court may be decided. In addition, OSHA, under public pressure, had undertaken a National Emphasis Program (NEP) inspection of the facility. The OSHA NEP inspection was expected to last until August or September 2011. Thus, for Bayer, it would be very difficult, if not impossible, to meet crop demands of 2011. They were left with a choice of starting up the plant for just one year's worth of crop demands or make the business decision to give up and withdraw from the case. Bayer decided to withdraw from the case and agree to never again start up the MIC unit.

The ultimate outcome of this series of events resulted in shutting down of a process or unit within a plant. While it should be recognized that ultimately society, directly or indirectly, is the final arbiter regarding such decisions; however, it is also very important to recognize that such decisions have other consequences such as loss of jobs, departure of industry, risk migration, economic impacts including

cost of products, independence from imports and availability of appropriate material.

### ***CBS News Report***

A final topic I would like to touch on is my interview in the CBS investigative report on, "Oil spills, leaks happen daily across U.S." Just like the previous two events discussed in this article, this one also brings forward issues of national and societal concern regarding chemical safety. We are spending millions and billions of dollars on various programs in industry and government. Yet, there is no way of knowing answers to simple questions like, "Are we getting safer?"

Referring back to a study done by the MKOPSC in 1999-2000, one fact was established—given the current status of incident information, there is no way of answering the question, "What is the status of chemical safety in the U.S.?" Both the CBS investigative report and our 1999-2000 research report shine the light on this glaring and unacceptable state of affairs.

In summary, we have to start collecting statistically valid information about incidents and their consequences on a national basis. Only then will we be able to answer the simple questions discussed above, we will be able to do trending analysis, we will be able to develop a cache of lessons learned and root causes. Only then will we be able to move towards fewer and fewer incidents hopefully resulting in a culmination of the vision of zero incidents.

*M. Sam Mannan*

**Spring, 2011**

## New Members

The Center welcomes several companies as new members of the consortium. Following is a complete list of MKOPSC Consortium members.

### Partners

- **Air Products\***
- BP
- ConocoPhillips
- Dow Chemical Company
- ExxonMobil Chemical
- Formosa Plastics
- Huntsman Corporation
- INVISTA
- **KMCO\***
- Occidental Petroleum
- TPC Group
- Shell International

### Sponsors

- AE Solutions
- AMOT/Metrix
- Apex Safety Consultants
- Atkins Americas
- **AVEVA\***
- DNV
- Exida/Risktec/Prospect
- GexCon
- **HIMA Americas\***
- KBR
- Lloyds Register
- **Sage Environmental Consulting\***
- Siemens OGM
- Wanger Consulting
- Zurich

### Associates

- ABS Consulting
- Kestrel
- Lisam
- PPG Industries
- Riskbytes

\* New members

More information on becoming a consortium member can be found at:  
<http://psc.tamu.edu/membership>,  
or by calling Ms. Valerie Green at:  
979/845-6884

## Research Topic Highlights for 2011

Of the research work going on at MKOPSC, many new research topics have been added for 2011. Three of the new topics are highlighted here.



**Rich Gustafson**, a PhD in Materials Science Engineering student is conducting research on: **Predictive Model for Stress-Corrosion Cracking** - Stress-corrosion cracking is a particularly insidious form of corrosion failure. It can occur with little to no advance warning and lead to the catastrophic failure of piping, structural materials, and process equipment. Recently, molecular dynamic modeling has resulted in a fundamental model that qualitatively correlates with experiential results of stress corrosion cracking in iron alloys and offers potential further insight into the underlying mechanisms. The purpose of this research is to develop and validate such a model.



**Mengtian Wang**, a Master's in Safety Engineering student is conducting research on: **Normalization of Process Safety Indicators Perspective** - From a normalization of process safety indicators perspective, this research aims to enhance the indicator on the process perception. Most of the industries measured safety performance by Lost Time Injury Rate /Total Recordable Injury Rate or similar personnel safety parameters. This research will try to find an improved or appropriate normalization method which contains process indicators as numerator and denominator to measure safety. This research will derive safety indicators for process industries that can properly depict safety performance and select reasonable data as process indicators to acquire the correlation between process losses and important safety indicators.



**Hai Le**, a PhD Chemical Engineering student is conducting research on: **Flammability Characteristics of Hydrogen Gas and Its Mixtures with Hydrocarbons** - The knowledge of flammability limits of hydrogen and its role in fuel mixtures is important for two reasons. Hydrogen is used in various industrial processes and is produced at great quantities worldwide, and compared with traditional fuels, H<sub>2</sub> poses unique safety hazards due to its unique physical properties. The research objective is to study the flammability characteristics of H<sub>2</sub> and its mixtures with hydrocarbons at ambient and non-ambient conditions. The research is both experimental and theoretical. The ultimate goal of this research is to define the role of H<sub>2</sub> in the flammability behaviors of its mixtures with hydrocarbon, and to propose a safe method when handling H<sub>2</sub> gas.



### **Mannan Testifies to Congress, Sound Science, Updated Safeguards Vital to Chemical Security**

Sam Mannan testified on chemical facility safety before a U.S. House of Representatives homeland security subcommittee. He stated that because the nation's chemical infra-structure was never designed with regard to preventing or responding to acts of terrorism, intensive research is needed to determine the most effective ways of safeguarding its existing aspects as well as new components.

Addressing the Subcommittee on Cybersecurity, Infrastructure Protection and Security Technology of the Committee on Homeland Security, Mannan underscored the importance of the development of updated standards and procedures for new chemical plants and delivery systems as well as the need to determine realistic implementation of safeguards for existing chemical plants.

Mannan did however, caution that mandating the evaluation and implementation of such inherent safety options must be based on sound science.

"Requirements for inherently safer technology should be based upon good science aimed at making the industry secure, avoid over-regulation, and create a level playing field," Mannan said. "U.S. facilities could be at a competitive disadvantage if required to implement unproven technologies simply to meet a regulator's position that such technology is more inherently safe."

Furthermore, added Mannan, in some cases, a seemingly clear choice with regard to inherent safety may create some undesired and unintended consequences, such as reducing risk associated with transport of a chemical while increasing the risk of storing that chemical. Given this potential, issues such as risk migration, reduction of overall risk and practical risk reduction should be evaluated whenever an inherent safety option is considered.

In addition to focusing on prevention of and protection from chemical-related disasters resulting from acts of terrorism and natural disasters, Mannan also emphasized the importance of response and recovery plans.

Most of the large, multi-national facilities that are members of major industry associations, he noted,

have voluntarily conducted some form of vulnerability analysis. What is not clear is whether these analyses have been used to integrate planning for response and recovery efforts in coordination with local agencies and the public.

"One very stark lesson from the 9/11 events is that the 'first' first-responders are usually members of the public," Mannan stated. "Whether natural or man-made, disasters will continue to happen," he added. "However, as we have seen with the 9/11 events, hurricanes Katrina and Rita, and chemical incidents such as the Bhopal disaster, planning and response is crucial in being able to reduce the consequences and to recover from the disaster more rapidly."

Towards this goal, it is essential to conduct vulnerability analysis, and response and recovery planning on a chemical plant-specific level, an area- and region-specific level, and a national level, Mannan explained.

In addition, Mannan called for science and technology investments across a wide variety of areas and leading to the development of incident data bases, which could be used for improving planning, response capability and infrastructure changes. "Recent experience in this regard is the improvement in planning and response for the hurricane Rita from lessons learned from the hurricane Katrina."

He also emphasized the need for research to be conducted on decision-making, particularly under stress, with the aim of improving management systems; basic and fundamental research on design of resilient engineered systems; and research on self-healing materials and biomimetics.

"Chemical security and protection of the chemical infrastructure is of extreme importance to our nation, and I am pleased that the U.S. Congress is continuing to pay attention to issues relating to chemical facility anti-terrorism," said Mannan.

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### Energy Forum 2011: Energy Security and Sustainability—Global Challenges

Sam Mannan was moderator of the “Safety Engineering in the Energy Sector” Special Session at the Energy Forum 2011: Energy Security and Sustainability- Global Challenges. Members of the panel included David Miller, Director, Standards at the American Petroleum Institute, and Robin Pitblado, Energy Director at HSE Services DNV (Det Norske Veritas).



*Sam Mannan     David Miller     Robin Pitblado*

The panelists discussed the attention to and concern over the safety of deepwater offshore energy systems. More broadly, safety engineering

in the energy sector is more important than ever as we explore the viability of new sources of energy; conversion processes; logistics; distribution infrastructure; and end use technologies integrated within existing systems. Intelligent risk-based decision making must enable new energy industries rather than impede them, while ensuring the absolute safety of workers. The panel explored safety engineering and discussed its importance in the broad energy sector.

The Forum, sponsored by ConocoPhillips and hosted by the Texas A&M University Energy Engineering Institute (EEI), was held in College Station, Texas, on February 1-2, 2011. The keynote speech was presented by Dr. Arun Majumdar, Director of Advanced Research Projects Agency- Energy (ARPA-E), a U.S. Department of Energy program office.

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### SOCMA To Host First U.S. EHS&S and Sustainability National Conference

The Society of Chemical Manufacturers and Affiliates (SOCMA) will address the issue of the chemical industry’s growing interest in sustainability practices, during a national conference on May 18 in Houston, Texas. Dr. M. Sam Mannan will deliver the Keynote Address entitled “The Relationship of Safety and Risk Management to Engineering for Sustainable Development.”

The *2011 EHS&S and Sustainability Conference*, will focus on the concept of sustainability and how it is defined for small and medium-sized chemical companies. Other speakers will include members of the US government, academia and industry will address how companies are changing their business models accordingly.

According to a SOCMA news release, “ChemStewards was founded on the principles of sustainability and continuous improvement six years ago,” said SOCMA’s ChemStewards Director J. Holland Jordan, Ph.D. “To that end, we decided to bring the best and the brightest in the industry together to discuss the immediate impact of sustainability on their business and what changes they intend to make in the future.”

### 2011 AICHE Spring Meeting

Two presentations from the Mary Kay O'Connor Process Safety Center were made at the AICHE Spring Meeting held in Chicago on March 13-16, 2011. In the *Fires, Explosions and Reactive Chemicals* session, Alba Pineda, PhD student in the Center, presented "Inherently Safer Reactor Design for Complex Reactions Based On Calorimetry Studies." In the *Sustainable Energy in Practice* session, "Sustainability and Safety Study for Biodiesel Production," was presented by Dr. Sharon Gao. In a continued effort to disseminate research activities and education opportunities, the Center also participated in the exhibitors area during the three-day conference.



### Short Course to be taught in Columbia

Dr. Sam Mannan and Dr. Jack Chosnek will be presenting the course "Fundamentals of Loss Prevention," at the Universidad de los Andes in Bogota, Columbia. The course will take place on July 25-29, during the university's International Summer School.

### Presented in Celaya

Dr. Sam Mannan presented "Inherently Safer Design," and Dr. Carl Laird presented "An Introduction to Algorithms for Continuous Optimization" at the 30th anniversary of postgraduate courses (M.Sc. and Ph.D. courses) during the Annual Seminar at the Celaya Institute of Technology in Celaya, Mexico. The event took place on January 10-14, 2011.

### Hazards XXII Conference

Dr. Sam Mannan presented the paper entitled "Stretch in Technology and Keeping the Focus on Process Safety for Exploration and Production in the 21st Century," and the poster "Analysis of CF3Br Inhibition Mechanism on Methane Premixed Combustion," S. Mannan, C. Osorio, E. Petersen and C. Mashuga at the *Hazards XXII* conference in Liverpool, England on April 12-14, 2011. This was the first year the Center participated as an exhibitor at the Conference.



### University of Ljubljana, Slovenia

On March 26-April 2, Dr. Sam Mannan traveled to Ljubljana, Slovenia to visit with the Faculty of Chemistry and Chemical Technology of University of Ljubljana Slovenia, including Mitja Kožuh, Chair of Occupational Safety. As part of the visit, Dr. Mannan presented a 2-day work-shop "Fundamentals of Process Safety and Risk Management" for students of the Department of Technical Safety.



### CAL OSHA Advisory Committee Meeting

On February 8, Dr. Sam Mannan attended the CAL-OSHA Advisory Committee meeting. The meeting was to discuss amendments regarding current standards on diesel engine safety for the oil drilling and production industry.

## Alumni News

Congratulations to **Dr. Nir Keren**, MKOPSC Alumni, for his promotion to Associate Professor with tenure (effective August 16) in the Agricultural and Biosystems Engineering Department at Iowa State University. Nir graduated from Texas A&M University, under the auspices of MKOPSC, in December 2003 with a PhD in Interdisciplinary Engineering. He continued to work as a research scientist with the Center before joining Iowa State as assistant professor of Occupational Safety in the department of Agricultural and Biosystems Engineering in 2005.



## 2011 International Symposium

### Keynote Speakers Announced

The keynote speaker on October 25 for the *2011 International Symposium* will be **The Honorable Lee H. Hamilton**. Lee Hamilton is president and director of the Woodrow Wilson International Center for Scholars, and director of The Center on Congress at Indiana University. Hamilton served for 34 years in Congress representing Indiana's ninth district, from January 1965 to January 1999.

Since leaving the US House of Representatives, Hamilton has served on the United States Commission on National Security in the 21st Century (the Hart-Rudman Commission), and was co-chair of the Baker-Hamilton Commission to Investigate Certain Security Issues at Los Alamos. Mr. Hamilton served as Vice-Chair of the National Commission on Terrorist Attacks Upon the United States (the 9/11 Commission), and as co-chair of the Iraq Study Group. He is Co-Chair of the National Security Preparedness Group with Tom Kean, Co-Chair of the National Advisory Committee to the Campaign for the Civic Mission of Schools with Justice Sandra Day O'Connor, co-chair of the Department of Energy Blue Ribbon Commission on America's Nuclear Future with Brent Scowcroft, and serves on the President's Intelligence Advisory Board, the FBI Director's Advisory Board, the US Department of Homeland Security Task Force on Preventing the Entry of Weapons of Mass Effect on American Soil, and the CIA External Advisory Board.



On day two, the keynote speaker will be **Dr. Edward J. Calabrese**. Edward Calabrese is a Professor of Toxicology at the University of Massachusetts, School of Public Health, Amherst. Dr. Calabrese's research interests include environmental toxicology with an emphasis on biological factors including genetic and nutritional factors that enhance susceptibility to pollutant toxicity and the environmental implications of toxicological hormesis. Hormesis describes the fact that low doses of some chemicals are stimulative or promote growth but higher doses are toxic or inhibit growth. Over the past 15 years Professor Calabrese has redirected his research to understanding the nature of the dose response in the low dose zone and underlying adaptive explanatory mechanisms.

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The *2011 International Symposium* of the Mary Kay O'Connor Process Safety Center will be held at the College Station Hilton Conference Center on **October 25-27, 2011**.

Registration, Exhibitor and other information can be found online at: <http://psc.tamu.edu/symposia/2011-sym> or call Donna Startz at 979/845-5981.



### Mannan Featured on CBS National News

Sam Mannan was recently featured in a CBS national news story for his research involving developing a national system of state-based surveillance measures in order to more effectively prevent and mitigate the consequences of hazardous substance-related incidents.

The CBS report “Oil spills, leaks happen daily across U.S.” featured Mannan, who commented on research he and center colleagues published as a white paper titled, “Developing a Roadmap for the Future of National Hazardous Substances Incident Surveillance.”

“If you don’t even know how many releases are occurring, if you don’t even know what the overall consequences are, you can not answer the question of whether we are safe enough.” Mannan stated in the nationally televised report.



An excerpt from the executive summary of the white paper on which Mannan based his comments states, “Currently, the United States is not yet utilizing all the tools at its disposal to prevent, as well as mitigate, the consequences of hazardous substance incidents. In order to properly manage something, it must be measured. Currently, the US does not even have an estimate of the magnitude of the consequences of hazardous substance releases.”

The full paper may be downloaded at: <http://pscfiles.tamu.edu/library/center-publications/white-papers-and-position-statements/Developing%20a%20Roadmap%20for%20the%20Future%20of%20National%20Hazardous%20Substances%20Incident%20Surveillance.pdf>

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### MKOPSC and Lisam America Inc. Collaborate on Research and Data Project

In a joint venture with Lisam Systems of Belgium and The Texas A&M University System (TAMUS), Lisam America Inc. headquartered in Bryan, Texas will provide ExESS(r) software sales, services and support to companies operating in the United States that manage workplace Environmental Health and Safety (EH&S). ExESS(r) is Lisam Systems’ flagship software, developed in Microsoft .net with Microsoft SQLServer, for global regulatory compliance solutions in Environmental Health & Safety. ExESS(r) delivers EH&S solutions in the areas of Chemicals Management, Inventory Management, Waste Management and Workplace Safety.

Lisam America also is expected to become the primary platform for Lisam Systems to commercialize process safety research and data from

the Mary Kay O’Connor Process Safety Center at Texas A&M University’s Artie McFerrin Department of Chemical Engineering.

Brett Cornwell, associate vice chancellor for the Office for Technology Commercialization at the Texas A&M System, in a recent news release by TAMUS, stated “With ExESS(r), we now have a global platform to commercialize process safety research and data gained from extensive collaboration with the chemical, energy and other process industries.”

Lisam America will help address compliance solutions for the U.S. market, including the upcoming U.S. adoption of the Global System for Harmonization and Classification of Hazardous Chemicals (GHS), volume tracking and reporting for hazardous chemicals.

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## 2011 Alumni Reunion

The Center held the 3rd Annual Alumni Reunion, sponsored by **Shell E&P**, on Sunday, April 3, 2011. Approximately, one hundred past and present students, staff and researchers and family members were in attendance. The day included a tour of the center's library, offices, and labs. After lunch entertainment included traditional Silsila melodies with flute and guitar music by Yogesh Babbar, a traditional Indian dance - Odissi, a puppet show for the kids and performances by Texas A&M University student groups the Ballet Folklorico Celestial and Aggieland Mariachis.

As in the past, the current students participated in a poster competition. Alumni cast their votes for their choice based on technical content and presentation of material. First place was presented to the Resilience and Sustainability team: Linh Dinh, Tony Rocha Valadez, and Jonathan Lizarazo . Second place went to the Combustion team: Diana Castellanos, Szu-ying Huang, Jiaojun Jiang, Hai Le, Peng Lian, Carmen Osorio, Derrick Thomas, Fuman Zhao, Camilo Rosas and Sergio Garcia. Finally, third place was presented to the LNG team: Carolina Herrera, Byung Kim, Anisa Safitri, Bin Zhang and Ruifeng Qi.





# Visitors to the Center



Recently MKOPSC has had the opportunity to host many visitors to the center and the Texas A&M campus. We would like to recognize our guests for their contribution and dedication to the center's mission of encouraging safer processes, equipment, procedures and management.

## Visiting Professor Jimenez-Gutierrez Presented Seminar on Process Integration Strategies

Visiting research professor Dr. Arturo Jimenez-Gutierrez presented his seminar "Applications of Mathematical Programming Techniques for the Synthesis of Mass Integration Networks" to the faculty and graduate students of the Artie McFerrin Department of Chemical Engineering and the Mary Kay O'Connor Process Safety Center. The seminar discussed his work on the application of mass integration networks to minimize the use of natural resources and production of waste in the chemical engineering industry.

Dr. Jimenez is a Professor of Chemical Engineering at the Instituto Tecnológico de Celaya in Mexico. He has received many awards and accolades in chemical engineering, including recently receiving a career award from the National Association of Engineering Schools in Mexico. He is working jointly with the Mary Kay O'Connor Process Safety Center for six months. The seminar was held on January 7, 2011.

## Calabrese Presents Seminar

Dr. Edward Calabrese, Professor at the University of Massachusetts, School of Public Health, visited the Center on May 5, and presented a seminar on Hormesis. Dr. Calabrese also met with the graduate students, researchers and faculty regarding ongoing Center research, during his stay.

## Visitors to the Center

This spring has brought other distinguished visitors to the Center.

Dr. Hans Pasman arrived for the month of February on one of his two annual visits to the Center. During his visit, he met with all 30 graduate students, three visiting students from Colombia and Center research staff.

Also in February, Dr. Phani Raj visited the Center and met with the graduate students, offering advice and suggestions on their research.

In March, the Center met with a delegation of researchers from Liaoning Shihua University in China. Those in the

group were Professor. Ji Chen, College of Mechanical Engineering and currently a visiting scholar at the TAMU department of Mechanical Engineering, Professor Xuebing Sui (Head of the delegation), Dean, College of International Education and Professor Gengxiang Luo, Dean, College of Chemical Materials. Having heard about the Center activities in China, the delegation wanted to meet with Center personnel and tour the labs, while at Texas A&M University also visiting the Mechanical Engineering department.

## Visiting Students at the Center

Several students from Universidad de los Andes in Columbia are currently studying at the Center. They are Sergio Garcia, Camilo Rosas, Jonathan Lizarazo and Carlos Cardenas, who study under Professor Felipe Munoz Giraldo at the University in Columbia.

Also, Dorota Siuta from the University of Lodz in Poland is visiting the Center. She is a student of Dr. Adam Markowski at the university in Poland.

### PhD Student Diana Castellanos Doing Dust Explosion Research at UiB and Gexcon

The Center joined with GexCon on several initiatives this past year. On August 30-31, 2010, GexCon and MKOPSC organized a joint offshore explosion course which was so well received by the industry that a second course is planned for May 19-20, 2011.



*2010 Explosion course live demo at Brayton Fire Training Field*

Another initiative developed was the exchange of researchers. Diana Castellanos, PhD student at MKOPSC, spent six months at GexCon and University of Bergen (UiB). Diana was accepted to study one semester abroad at UiB, Department of Physics and Technology, completing an advanced dust explosion course. At the GexCon R&D Center, Diana dove deeper into the field of dust explosions through simulations and laboratory experiments under the supervision of Trygve Skjold.



*Photo courtesy of GexCon—Diana with explosion test equipment*

on gas and dust explosion tests in a 3.6 meter flame acceleration tube. She performed a comparison of dust dispersion and explosion pressure profiles in the 36 L explosion vessel at Texas A&M University and in the standard 20 L vessel at GexCon AS. This analysis will be useful to determine the proper extraction of combustion parameters from her experiments at Texas A&M, and to generate input data for DESC simulations. As a result of this work, several joint publications are underway.

Diana performed dust explosion simulations using DESC in different geometries including venting of dust explosions through ducts, coal dust explosions in a full scale roller mill and analysis of the transient turbulent flow in a 36 L explosion vessel. Her work focused on identifying limitations and potential improvements of these venting equations.

Diana performed standard dust explosion tests with the 20 L apparatus and worked with Trygve



## MKOPSC Faculty Fellows

### El-Halwagi Appointed National Chair for CAST, Academic Trustee for CACHE



**Mahmoud El-Halwagi**, professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, has been appointed national chair for the American Institute of Chemical Engineers (AIChE) Computing and Systems Technology (CAST) Division as well as an academic trustee for the Computer Aids for Chemical Engineering (CACHE) Corp.

CAST, the leading division for process systems engineering in the chemical engineering community, is responsible for the wide range of activities within AIChE that involve the application of computers and mathematics to chemical engineering problems including process design, process control, operations and applied mathematics.

Last year, El-Halwagi served CAST as the first vice chair after having been previously elected to serve as the second vice chair one year prior. As national chair, El-Halwagi will preside over all meetings of the CAST Division and its executive committee.

“My priority is to launch several initiatives for enhancing membership, engaging a larger number of participants in CAST-sponsored scholarly activities, and creating new services for members,” El-Halwagi said.

One of El-Halwagi’s first actions as a chair has been the establishment of a lifetime membership program for CAST members. Additionally, El-Halwagi, who also serves as the chair of the AIChE International Subcommittee on Joint International Meetings and Special Sessions, plans to develop synergistic partnerships with other organizations through co-sponsoring conferences, workshops and sessions.

Holder of the McFerrin Professorship, El-Halwagi is internationally known for his pioneering contributions in the fields of sustainable design and process integration, and he has written two widely used texts on the subject. He conducts research and teaches classes covering the areas of sustainability,

energy conversion, novel energy technologies, process design, simulation, economics, integration and optimization. (*Article adapted from department news story.*)

### Hall to Lead Research and Graduate Studies at Texas A&M University at Qatar

**Kenneth R. Hall**, professor of chemical engineering and deputy director of the Texas Engineering Experiment Station (TEES), has accepted the positions of associate vice chancellor and associate director of TEES and associate dean for research and graduate studies at Texas A&M University at Qatar. In these roles,



he will report to the vice chancellor and dean of engineering and director of TEES at College Station and the dean and chief executive officer of Texas A&M at Qatar, respectively. Hall will assume the post on April 1, relocating to Doha, Qatar, where he will serve a 4-year term.

### Laird Named Holder of Neely Faculty Fellowship in Chemical Engineering

**Carl Laird**, assistant professor in the Artie McFerrin Department of Chemical Engineering, has been appointed holder of the *William and Ruth Neely Faculty Fellowship in Chemical Engineering*, by Vice Chancellor and Dean of Engineering G. Kemble Bennett.



The appointment is for a three-year period, effective May 1.

Laird’s research focuses on large-scale nonlinear optimization, parameter estimation, and parallel computing. Particular applications include network problems, where he has worked on developing algorithms as part of an early warning contaminant detection system in municipal drinking water networks. In addition, Laird is involved in the modeling and optimization of infectious diseases, working to determine the fundamental driving forces affecting the spread of infectious disease in both time and space.

## El-Halwagi Named Texas A&M AIChE Faculty of the Year

**Mahmoud El-Halwagi**, professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, has been named recipient of the Faculty of the Year Award, presented by Texas A&M's student chapter of the American Institute of Chemical Engineers (AIChE).

The chapter presents this award to a faculty member that has demonstrated outstanding dedication and service to the chemical engineering student body during the year.

"This award means a lot to me coming from the students, especially from a fine student body: the AIChE Student Chapter," El-Halwagi said in a department article. "It is such a great honor and privilege to interact with Texas A&M's chemical engineering students. They are some of the finest in the world."

## Laird Receives Prestigious Wilkinson Prize for Numerical Software

**Carl Laird**, assistant professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, has been named recipient of the prestigious *Wilkinson Prize for Numerical Software* for the development of IPOPT, a software library for solving nonlinear, nonconvex, large-scale continuous optimization problems.

He will receive the international award along with colleague Andreas Waechter of the IBM Thomas J. Watson Research Center. The Wilkinson Prize, sponsored by Argonne National Laboratory, the Numerical Algorithms Group and the National Physical Laboratory, is awarded every four years. Laird and Waechter are scheduled to receive their

awards at the 2011 International Congress on Industrial and Applied Mathematics in Vancouver, British Columbia, Canada.

This software, IPOPT, is an object-oriented software library that facilitates the solution of large-scale continuous optimization problems. IPOPT is available from the COIN-OR open source repository, and interfaces for modeling languages (AMPL, GAMS), and for MATLAB, R, Java, and Python are included. In addition, IPOPT allows the use of several third-party solvers of sparse, symmetric indefinite linear systems. IPOPT has extensive documentation and a tutorial that allows users to install and use the package in a short period of time.

## El-Halwagi Appointed to Advisory Board for Center for Energy Initiatives

**Mahmoud El-Halwagi**, professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, has been appointed to serve on the inaugural advisory board of the Center for Energy Initiatives. Launched by the American Institute of Chemical Engineers (AIChE), the center aims to identify opportunities beyond the current AIChE energy activities, develop plans to respond to opportunities, facilitate and coordinate implementation, and find ways to focus expertise and the work of AIChE members from different energy related divisions and activities towards reaching common goals pertinent to serving the energy needs of society.

The center has undertaken a number of research and education projects, including the coordination of a project on carbon management for a group of leading engineering societies. In addition, work is under way on an intersociety, interdisciplinary project to develop energy metrics that will allow for consistent comparison of diverse energy options. The center also is developing energy education modules for undergraduate chemical engineering curriculum.

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### THREE QUESTIONS

#### Do We Need To Follow All The Rules?

*The two following quotations are from the introduction by Vladimir Horowitz to Deutsche Grammophon CD 445517-2:*

“Mozart believed that the left hand should always remain strictly in time, while the right hand may enjoy rhythmic freedom.”

“Some 60 years later, Chopin paraphrased Mozart: ‘The left hand is the conductor: it must not waver or lose ground; do with the right hand what you will and can.’”

Mozart's views can be applied to process safety (and many other problems). Some safety rules are “Left hand” ones, that should always be followed. Others are “Right hand” ones, recommendations that managers should consider but need not always follow. The results of a quantitative risk assessment (QRA) are often “Right hand” ones. For example, after a serious accident a manager might decide to make greater changes than those justified by a QRA, in order to satisfy the concerns of employees and the public. Or he might make fewer changes than recommended by a QRA as he knows the plant will be shut down soon. He but might make changes in operations rather than changes to the equipment.

#### Are Meetings Worthwhile?

I have attended many meetings on accidents in the last 50 plus years. Those that shared or exchanged information were on the whole worthwhile. Those that were intended to discover the causes of a company's accidents as a whole, and how to prevent them, were mainly a waste of time. Why? Because everyone present has different views, different levels of knowledge, different experience. Any novel suggestions are opposed by someone so the only proposals they can all agree on are generalities. As a process safety adviser in the UK chemical company, ICI, I soon learned not to suggest in a meeting what I was going to do, as someone might disagree. Instead I described what I had done and discussed my new, untried ideas with people who were able to comment on cost, practicality, etc.

I have often argued that official reports on accidents include only the more obvious causes and recommendations and that new ideas like inherently safer design, Hazop and QRA are produced by individuals or small groups of like-minded people. New ideas rarely arise in meetings.

#### Why Does Equipment Fail in Service?

*The following quotations are from an article by Ian Walmsley in the UK Journal, Modern Railways, January 2011, entitled “Why do trains fail in service?” Most of what he writes applies to other equipment.*

Imagine the old juggler's routine of spinning plates marked, Reliability, Availability and Cost. If you spend your time spinning up reliability you stop more trains for repairs, so availability starts to wobble. Take on more staff or buy more replacement parts and your budget lies shattered on the floor ...

The success of this imperfect system depends on the depot engineer who must motivate, manage, direct and discipline the system to make sure everything works. Despite this grief it is still the best job I ever had ...

For various reasons some things don't get done and will eventually fail. The approach of some less experienced managers is then, for example, “Bearing X was greased during the examination three weeks ago, so we must grease it more often so that it won't fail again”. The approach should have been “Who signed this as done but hadn't done it?”...

I have worked in a few depots which could manage with half the staff, as long as it was the right half.

## Case Histories

### **XCEL Energy Hydroelectric Tunnel Fire during Penstock Tunnel Recoating**

Presented by Shubharthi Barua at the January 20, 2011 Steering Committee Meeting

A Chemical fire occurred at Xcel Energy's Cabin Creek Hydroelectric Plant on October 2, 2007 inside penstock, which is an OSHA permit required confined space. As interior coating and linings of the penstock was deteriorated, Xcel Energy initiated repair projects to remove old penstock linings and replace them with newer epoxy coatings and awarded the contract to RPI Coating Inc. When RPI workers started epoxy application, they encountered some problems and were unable to apply epoxy evenly on the penstock wall. The workers shut-down the sprayer equipment and began cleaning and flushing the sprayer system with Methyl Ethyl Ketone, which is a highly flammable solvent listed by National Institute of Occupational Safety and Health. During the cleaning process, MEK vapor ignited and flashed. The resulting fire grew quickly consuming open buckets of MEK and epoxy inside the penstock. There was only one access and egress point in the penstock. The five workers who were trapped by fire opposite to the exit were unable

to evacuate the penstock died due to smoke inhalation. Four other workers who were near the exit, evacuated the penstock. Three of them were treated for injuries.

CSB made several recommendations to OSHA, Xcel Energy, RPI Coating Inc. and several other public agencies. CSB recommended OSHA amend its permit-required confined space rule for general industry and to establish a maximum permissible percentage substantially below the lower explosive limit for safe entry and occupancy in permit-required confined spaces. For Xcel Energy, CSB recommended to modify its contractor selection policy and to implement written verification procedures for the safety information and documentation submitted by contractors. CSB recommended RPI Coating Inc. to revise its confined space entry program and to hire a certified safety professional to conduct periodic safety audits at their worksites. CSB also recommended RPI to provide adequate training to all its workers prior to the beginning of any project.

### **Heat Exchanger Rupture and Ammonia Release, Goodyear, Houston**

Presented by Sally Nicola at the March 3, 2011 Steering Committee Meeting

Goodyear is an international corporation founded in 1988. It has many branches all over the world and is headquartered in Akron, Ohio. In Texas, Goodyear has 4 branches. One of these branches is located in Houston, Texas where this accident happened in 2008. This facility includes separate production and finishing areas. In the production area, there are three shell and tube heat exchangers that use ammonia to cool down the chemicals used to make synthetic rubber. The ammonia flows in the shell of the heat exchangers and the rubber chemicals flow in the inner tubes. To protect from overpressure, each heat exchanger is equipped with a rupture disk in series with a relief valve.

On June 10, 2008, the rupture disk on one of the heat exchangers was to be replaced and an isolation valve was closed between the shell of that heat exchanger and the relief valve in order to replace the rupture disk. The

rupture disk was replaced, but the isolation valve was left closed. The following day, the inner tubes of the heat exchanger were to be cleaned. To do that, a block valve isolating the pressure control valve on the ammonia side of the heat exchanger was closed, leaving the ammonia trapped between the closed isolation valve and the block valve. The steam that was flowing in the inside tubes of the heat exchanger was hot and started raising the temperature of the ammonia, hence raising its pressure. The pressure kept building up until the heat exchanger ruptured violently at 7:30 am. The debris from the explosion struck and killed an operator and the ammonia vapor injured six workers who were working nearby. CSB investigated this accident and found that Goodyear had problems with their emergency procedures, maintenance procedures, and pressure vessel overpressure protection.



## Case Histories

### **Seven Key Lessons to Prevent Worker Deaths during Hot Work In and Around Tanks**

Presented by Michael Trevathan at the April 27, 2011 Steering Committee Meeting

The presentation emphasized the reoccurrence of incidents during hot work -- in and around tanks. Good-practice recommendations and standards are well established for hot work; however, many injuries and fatalities are still occurring. Since 1990, CSB has identified 60 fatalities associated with this type of hot work. The presentation discussed seven key lessons that CSB derived from the hot work accidents that they investigated. The most prevalent and detrimental deficiency was the lack of continuous air monitoring with combustible gas detectors. Continuous air monitoring would have identified the presence of combustible gases well before reaching an explosive level. Hot work is a dangerous practice that should be avoided, however, if necessary, the proper training and safety precautions should be implemented.

### **ConAgra Natural Gas Explosion and Ammonia Release, Garner, NC**

Presented by Bin Zhang at the April 26, 2011 Technical Advisory Committee Meeting

The incident of ConAgra occurred on June 9, 2009, in Garner, NC. During the installation and commissioning of a new water heater by Energy Systems Analysts, the new gas piping was directly purged into the room with natural gas. This practice, using the sense of smell alone to detect natural gas, eventually resulted in the explosion and the following ammonia release, which caused four deaths and 67 injuries. The investigation conducted by CSB found some gaps in current codes and standards and recommended NFPA, AGA and ICC to enact a tentative amendment to National Fuel Gas Code, which would require vent purging gas outdoors, and standards to purging indoors, if it is necessary.

## Recent Publications

1. Markowski, A.S. and M.S. Mannan, "ExSys-LOPA for the chemical process industry," Journal of Loss Prevention in the Process Industries, vol. 24, no. 6, November 2010, pp. 688-696.
2. Rana, M.A. and M.S. Mannan, "Forced dispersion of LNG vapor with water curtain," Journal of Loss Prevention in the Process Industries, vol. 24, no. 6, November 2010, pp. 768-772.
3. Jung, S., D. Ng, C.D. Laird and M.S. Mannan, "A new approach for facility siting using mapping risks on a plant grid area and optimization," Journal of Loss Prevention in the Process Industries, vol. 24, no. 6, November 2010, pp. 824-830.
4. Carreto-Vazquez, V.H., A.K. Wójcik, Y.-S. Liu, D.B. Bukur, and M.S. Mannan, "Miniaturized Calorimeter for Thermal Screening of Energetic Materials," Microelectronics Journal, vol. 41, no. 12, December 2010, pp. 874-881.
5. Carreto-Vazquez, V.H., Y.-S. Liu, D.B. Bukur, and M.S. Mannan, "Chip-Scale Calorimeters – Potential Use in Chemical Engineering," Journal of Loss Prevention in the Process Industries, vol. 24, no. 1, January 2011, pp. 34-42.
6. Suardin, J.A., R. Qi, B.R. Cormier, M. Rana, Y. Zhang, and M.S. Mannan, "Application of fire suppression materials on suppression of LNG pool fires," Journal of Loss Prevention in the Process Industries, vol. 24, no. 1, January 2011, pp. 63-75.

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## Upcoming Events

Many events are scheduled in the next few months. Registration for these events are filling up and seats are limited! Take advantage of early registration discounts when offered.



# **GAS EXPLOSION HAZARDS ON OFFSHORE FACILITIES**

## **AN ADVANCED COURSE**

**19th—20th MAY 2011**

**Presented by GexCon & Mary Kay O'Connor Process Safety Center**

### MKOPSC — Continuing Education

**August 17**  
**8:30am – 4:30pm**

**[Reactive Chemical Hazards Assessment](#)**

Location: PCCT Center; Houston, TX

0.7 CEUs/ 7 PDHs

[Register for this course](#)

**In August – *NEW!***  
**8:30am – 4:30pm**

**[Combustible Dust Explosion Hazard Awareness](#)**

Location: Texas A&M University

College Station, TX



**October 25-27, 2011**

**[2011 INTERNATIONAL SYMPOSIUM](#)**

**[Mary Kay O'Connor Process Safety Center](#)**

College Station Hilton Conference Center

**—Early registration ends September 25**

67th Annual on January 24-26, 2012

**INSTRUMENTATION  
SYMPOSIUM**

**January 24-26, 2012**

**[67th Annual Instrumentation Symposium  
for the Process Industries](#)**

**Texas A&M University**

College Station, TX

# Safety Engineering Courses — FALL 2011

**Classes start August 30, 2011. Register Now!**

## **Distance Learning Objectives**

These distance learning courses are eligible for academic credit, Professional Development Hours (PDHs) or Continuing Education Units (CEUs)\*. To receive academic credit for the courses, you must be a currently enrolled student at TAMU.

**DISTANCE  
LEARNING**

## **SENG 310: Industrial Hygiene Engineering**

Application of scientific and engineering principles in the selection and design of control systems related to chemical, physical and ergonomic exposures in the process and manufacturing industries; relationships of criteria, analysis, and specifications for the assessment and control of occupational related illnesses. Prerequisites: CHEM 107; MATH 308; PHYS 208; or approval of instructor.

## **CHEN 455/655 – SENG 455/655: Process Safety Engineering**

Applications of engineering principles to process safety and hazards analysis, mitigation, and prevention, with special emphasis on the chemical process industries; includes source modeling for leakage rates, dispersion, analysis, relief valve sizing, fire and explosion damage analysis, hazards identification, risk analysis, accident investigations.

## **CHEN 430 – SENG 430: Risk Analysis Safety Engineering**

Concepts of risk and risk assessment, which uses all available information to provide a foundation for risk-informed and cost-effective engineering practices; examples and exercises are drawn from a variety of engineering areas. Prerequisite: Junior or senior classification.

## **SENG 321: Industrial Safety Engineering**

Concepts of designing, operating and maintaining optimally safe systems, risk management, economic impact, legislation, performance measurement and accident investigation/analysis; principles and practices in industrial hygiene engineering, fire protection engineering and introduction to systems safety engineering.

## **SENG 422: Fire Protection Engineering**

Fire protection design concepts and considerations for chemical, petrochemical and hydrocarbon processing facilities. Special attention given to fire hazard analysis, fire risk assessment, fire protection features, and emergency response. Specific fire protection design considerations are studied for the various types of facilities and processes. Prerequisite: Instructor approval.

**On-line registration is available at:**

**<http://psc.tamu.edu/education/distance-learning/fall-2011-courses>**

\*CEUs will be issued through the Mary Kay O'Connor Process Safety Center upon successful completion of the course.

**<http://psc.tamu.edu/education>**

### **For questions, contact:**

Valerie Green  
Mary Kay O'Connor Process Safety Center  
3122 TAMU - 244 Jack E. Brown Building  
College Station, TX 77843-3122  
Phone: (979) 458-1863  
E-mail: [val-green@tamu.edu](mailto:val-green@tamu.edu)



# Mary Kay O'Connor Process Safety Center

Beyond Regulatory Compliance, Making Safety Second Nature

## 2011 INTERNATIONAL SYMPOSIUM

**October 25-27, 2011**

**Hilton Conference Center**

**College Station, Texas**

**Early registration ends September 25**

This symposium serves as the crossroads for process safety where industry, academia, government agencies and other stakeholders come together to discuss critical issues of research in process safety. Experts from around the world will gather as part of this two and a half-day symposium, to share the latest information on the hottest topics aimed at making the process industry a safer place.

The symposium "Beyond Regulatory Compliance, Making Safety Second Nature" is scheduled for Oct. 25-27, 2011 at the Hilton Conference Center and will feature wide variety of safety-related lectures and presentations, including:

**Metrics for Safety Performance** – Leading and Lagging Indicators, Industry vs. Organization

**Process Safety Career Development and Education**

**Engineering for Resilience**

**Case Studies** – Histories, Lessons Learned, Databases

**Inherently Safer Processes** – New Processes, Existing Plants, Man – Machine Interface

**Human Factors** – Engineering, Behavioral Safety, Human Error

**Management for Process Safety** – PS Engineering, PSM components, PSM with limited resources, Innovative strategies for improvement

**Accident Investigation**

**Safety Culture** – Relationship to high consequence/low probability events

**Facility Siting** – Personnel Siting

**LNG** – Design, Experiment Evaluation, Consequence Analysis, Mitigation, Research needs, Regulations

**Control Systems** – Unusual Situation Mgmt., Safety Instrumented Systems, Integrity Levels, Reliability analysis, Reliance on SIS, Alarm Mgmt.

**Risk Assessment, Analysis and Management**

**Reactive Chemistry** – Predicting Reactivity, Role of Contaminants, Catalysts and Inhibitors, Case Histories, Experimental Methods

**Equipment Integrity** – Design for Maintenance, Maintenance Hazard Analysis, Monitoring

**In addition, the symposium will feature an exhibit area where companies can demonstrate products, technology and software related to process safety.**

Registration information and other details are available on-line at: <http://psc.tamu.edu/symposia/2011-sym>

Mary Kay O'Connor Process Safety Center • Texas A&M University • College Station, TX 77843-3122

Phone: 979.845.3489 • Fax: 979.458.1493 • <http://process-safety.tamu.edu>



# Mary Kay O'Connor Process Safety Center

Invites you to **EXHIBIT** at the  
**2011 International Symposium**  
*Making Safety Second Nature*



**Booth fee: \$1250**

**Includes:**

- 10'X10' booth
- electrical hookup
- table/chairs
- listing in meeting programs, print and online

**October 25-27, 2011**  
**Hilton Conference Center**  
**College Station, Texas**

Register Online:

<http://psc.tamu.edu/symposia/2011-sym/exhibitors>

<http://process-safety.tamu.edu>

Contact Donna Startz – [donnas@tamu.edu](mailto:donnas@tamu.edu), 979-845-5981

# Calendar of Events

**Upcoming Short Courses:** (For more info see: <http://psc.tamu.edu/education/continuing-education>)

**May 19 – 20**

**8:30am – 4:30pm**

**Gas Explosion Hazards on  
Offshore Facilities** New!

Instructor: GexCon Staff  
Location: Jack E. Brown Bldg.;  
Texas A&M University,  
College Station, TX  
1.3 CEUs/13 PDHs  
[Register for this course](#)

**May 25**

**8:30am – 4:30pm**

**Engineering Decision Making** New!

Instructor: Rogers  
Location: PCCT Center;  
Houston, TX  
0.7 CEUs/ 7 PDHs  
[Register for this course](#)

**August 17**

**8:30am – 4:30pm**

**Reactive Chemical Hazards  
Assessment**

Instructor: Rogers  
Location: PCCT Center;  
Houston, TX  
0.7 CEUs/ 7 PDHs  
[Register for this course](#)

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## Symposia:

**October 25-27, 2011**

**2011 SYMPOSIUM**

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

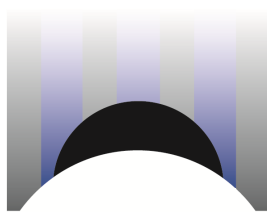
College Station Hilton Conference Center

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