

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

Chemical Engineering Division of the Texas Engineering **Experiment Station**

The Texas A&M **University System**

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Alumni Reunion

The Center will host its **Third Annual Alumni Reunion** on April 17th at the Jack E. Brown Chemical Engineering Building at TAMU in College Station. Over one hundred alumni, staff and current students of the Center are expected at the event. The day will feature presentations by past and present students, a poster competition, and a family dinner with entertainment.

Beyond Regulatory Compliance, Making Safety Second Nature October 26-28, 2010

The Mary Kay O'Connor Process Safety Center is extending the Annual **International Symposium!** Based on your feedback at past symposiums, a common interest in having the ease and opportunity of attending presentations in multiple sessions was evident. This topic was brought to the January meeting of the Center's Steering Committee 2 ½ day schedule was unanimously voted on and passed for the October 2010 Symposium.

The 2010 symposium program will be posted soon on the Center's website. On-line registration for the symposium and exhibits is currently available at: http://psc.tamu.edu/symposia/2010.

Tent Workshop Co-Sponsored by MKOPSC

API, NPRA and MKOPSC sponsored a conference on the emerging topic of the use of Tents and Fabric Structures at Refineries and Petrochemical Plants. The forum was held January 28-29, 2010 at the Houston Airport Marriott.

Presentations from the conference are available on-line at:

http://www.api.org/meetings/proceedings/2010-tent-forum.cfm



Director's Corner

March 23, 2010 was the 5th anniversary of the BP, Texas City incident. It is impossible to coherently and concisely describe everything I feel today even after the passage of five years. Naturally, I feel a lot of sadness and grief over the tragedy. It changed a lot of lives and also led to the unique settlement resulting in gifts to Texas A&M University and other organizations. But then I also feel a sense of pride and accomplishment in the quality and value of the programs of the Mary Kay O'Connor Process Safety Center that have been supported and strengthened by this gift.

First, let me say this to everyone who lost their loved ones in this tragedy. We are saddened by this tragedy and the loss of your loved ones. I know there is no way to lessen your grief or replace your loss. We mourn with you and please trust me when I say that we, at the Center, are doing our best in our efforts in teaching, research, and service activities. We truly and sincerely believe that education can be an influencing factor as we move towards improving safety performance in the industry.

Second, I want to recognize BP for taking complete responsibility for the incident, conducting a thorough internal incident investigation, cooperating with various external investigations, and commissioning an unprecedented blue-ribbon panel headed by Secretary Baker to look at organizational causes that led to the incident. All of these investigations led to significant lessons learned and recommendations for improved plant design, operations, and management systems. I am gratified to note that the there is a significant effort to implement the lessons learned from the Texas City disaster not only at BP, but throughout the industry.

Third, Texas A&M University's Dwight Look College of Engineering is nationally known for its engineering safety and ethics programs. The donation has benefited Texas A&M's Mary Kay O'Connor Process Safety Center and other programs in many ways:

- Aerosol equipment
- Retrofitting of dust explosion equipment
- Development of fire suppression materials
- Limited amount of LNG experiments and testing
- Scholarships for safety engineering certificate for Under Graduates
- General support for graduate students engaged in process safety research
- Augmentation of engineering ethics program
- Support for MS in Safety Engineering

Of course, these programs are in addition to continuation of a host of other programs and research activities that enhance safety in the chemical process industries. The use of chemicals is a two-edged sword. Safe use creates a healthier economy and a higher standard of living. Unsafe use threatens our lives, our businesses, and ultimately our world. Often it's a not a matter of can we be safe, but do we choose to be safe.

Making safety second nature is part of our mission. Our primary mission is to provide education and research opportunities to graduate and undergraduate students studying in the center. These young people are the ones who are preparing to enter the workforce with a sound grounding in process safety, and they can make a difference in the future of workplace safety. We have established aggressive programs for teaching, research and service. In teaching, we have introduced undergraduate and graduate curriculum in process safety and risk assessment. We also have established continuing education and training programs for industry professionals. In research, we currently have the largest research group by any measure - 30 graduate students conducting research in various areas of process safety including new and emerging areas. In service, we have established outreach programs with various organizations and universities both in the US and overseas.

> M. Sam Mannan Spring, 2010

Recent Publications

- 1. Vázquez-Román, R., J.-H. Lee, S. Jung, and M.S. Mannan, "Optimal facility layout under toxic release in process facilities: A stochastic approach," Computers and Chemical Engineering, vol. 34, Issue 1, January 2010, pp. 122-133.
- 2. Carreto-Vázquez, V.H., I. Hernández, D. Ng, W.J. Rogers, M.S. Mannan, "Inclusion of Pressure Hazards into NFPA-704 Instability Rating System," Journal of Loss Prevention in the Process Industries, vol. 23, no. 1, January 2010, pp. 30-38.
- 3. Rana, M.A., Y. Guo and M.S. Mannan, "Use of Water Spray Curtain to Disperse LNG Vapor Clouds," vol. 23, no. 1, January 2010, pp June 6, 2009, 77-88.
- 4. Jung, S., D. Ng, J.-H. Lee, R. Vázquez-Román and M.S. Mannan, "An approach for risk reduction (methodology) based on optimizing the facility layout and siting in toxic gas release scenarios," vol. 23, no. 1, January 2010, pp. 139-148.
- 5. Yang, X., W.J. Rogers and M.S. Mannan, "Uncertainty delimitation and reduction for improved mishap probability prediction: application to level control of distillation unit," vol. 23, no. 1, January 2010, pp. 149-156.

News & Events

Visitors to the Center

This spring has brought many distinguished visitors to the Center.

Dr. 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, 8 visiting students from Colombia, Center research staff as well as students working with the Faculty Fellows.

Also in February, visitors from the University of Antofagasta in Chile met with the Center members and Faculty Fellows to discuss potential areas of collaboration. Dr. Luis Cisneros and Dr. Edelmira Galvez Ahumada are both interested in process design, optimization and simulation. After very productive discussions and tour of the labs, we believe there are areas of research that would be interesting for both institutions.

From our industry contacts, we had several visitors to the Center this spring. In January, Shell Global visited to continue discussions regarding our academic program, continuing education opportunities and student research as well as discuss recruiting efforts. A Conoco Phillips representative visited recently to discuss similar matters and to reacquaint themselves with Center

activities. Finally, we had a visitor from INOVx, Mr. Blair Sullivan, demonstrate the capabilities of their product to the students and research staff. Mr. Sullivan summarized their product as using "engineering design models, 3D laser scan images and basic documentation to build a high fidelity *Intelligized* virtual plant model that mirrors a manufacturing facility."

Scheduled to visit late spring are Dr. Maria Papadaki, Dr. Maria Molnarne and Mr. Roy Sanders. We will have more on their visits in the summer newsletter.

Student News

This spring brought several new student faces to the group. In one semester, we welcomed 6 graduate students (both MS and Phd) and 5 visiting students from Colombia. Our new graduate students are Byung Kim, Phillip Hodge, Derrick Thomas, Alba Pineda, Szu Ying Huang, and Hai Le. Visiting for 6 months to complete a short-term research project with the Center from the University de los Andes and the University de Santander are: Florangela Quintero, Jose Lievano, Jonatan Batista, Paola Acevedo and Camilo Rosas

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Honors & Recognition

2010 AIChE Spring Meeting & 6th Global Congress on Process Safety

Several MKOPSC students presented papers at the Spring 2010 meeting of the AIChE and GCPS. **Yuan** Lu presented "Prediction of the Reactivity Hazards for Organic Peroxides Using QSPR Approach;" **Sarah Yang** presented "Pareto Optimization On Component Inspection Interval for Level Control in An

Oil/Gas Separation System;" **Seungho Jung** presented "Optimizing Facility Siting and Layout through Mapping Risk Estimates On Plant Area and Monetizing;" **Sean Legg** presented "Parallel Nonlinear Programming Decomposition for Design Under



Dedy Ng, Seungho Jung, Yuan Lu

Units;" Suhani Patel presented "Integrating Safety Issues in Solvent Selection and Process Design;" Seungho Jung presented "A New Approach to Optimizing Facility Layout by Mapping

Risk On Grids;" **Qingsheng Wang**presented "RIV and

SSIV Installations On Deepwater Platforms: A Decision Making Screening Tool;" **Ruifeng Qi** presented "Uncertainties in Modeling LNG Vapor Dispersion with CFD Codes;" and **Geun Woong Yun** presented "A Medium-Scale Field Test On Expansion Foam Application – Key Findings of LNG Pool Fire Suppression on Land."



Geun Woong Yun



Sharon Gao, Yuan Lu, Sarah Yang, Suhani Patel

TAMUQ Safety Symposium

Dr. Simon Waldram, Professor of Chemical Engineering at TAMU- Qatar was key in organizing the Safety Symposium held at TAMU- Qatar on March 15 and 16, sponsored by Shell, Exxonmobil and QP. Several faculty from the Artie McFerrin Department of Chemical Engineering participated in the symposium: Dr. Carl Laird (Center Fellow), Dr. Sam Mannan, and Dr. Hans Pasman (Research Professor with the Center). In addition, research associates of the center, Drs. Maria Papadaki and Dr. Adam Markowski, attended and presented as well. Panel discussions during the 2-day conference focused on safety culture and LNG spills: experiments and modeling.

Tsingua University Collaboration

For 2 weeks in March/April, Dr. Mannan presented a short course to students at Tsinghua University in China. During this visit, Dr. Mike Pishko, Department Head, Artie McFerrin Department of Chemical Engineering and Dr. Mannan had several meetings with representatives from Tsinghua University regarding options for collaboration. These discussions included: Dual or joint degree program for MS in Process Safety Engineering; Graduate student exchanges between Tsinghua and TAMU; and Internships for Tsinghua undergraduate chemical engineering students at TAMU. As noted in earlier newsletters, similar discussions are happening with other universities in hopes to be able to teach more students process safety and chemical engineering.



Honors & Recognition

Mannan at Qatar Safety Conference

Source ::: THE PENINSULA

DOHA: Lessons learned from past safety incidents are informing important research on chemical process safety that benefits the energy industry in Qatar and throughout the world, said Dr Sam Mannan during his talk for the Texas A&M at Qatar distinguished lecture series recently.

"Safety incidents have occurred all over the world," said Mannan, Regents Professor, holder of the T Michael O'Connor Chair I and director of the Mary Kay O'Connor Process Safety Centre at Texas A&M



University. "From these past events, we can reduce such incidents by integrating research results into our teaching and training programmes."

Mannan's lecture, "Lessons Learned from Past Incidents Shed Light on Present Day Needs and Challenges in Process Safety," focused on why the science, education and research for process safety are important, and provided a framework in which industry, government, academia and other stakeholders can work together to reduce the probability of occurrence and the consequences of serious incidents.

More than 100 guests from local industry attended the second installment of the Texas A&M at Qatar distinguished lecture series in the Texas A&M Engineering Building. The lecture series is designed to bring eminent speakers to campus to expose students, faculty and staff as well as the larger Doha community to a variety of important topics.

Dr James Holste, associate dean for research and graduate studies, said Mannan's talk provided invaluable information about an important field.

"Texas A&M University at Qatar is pleased to host Professor Mannan to provide to the local community access to his knowledge and expertise in the area of process safety," Holste said. "The lecture subject is extremely important to the success and profitability of operations in the chemical industry, and especially for the protection of the people who work in this industry."

The second part of the lecture considered LNG

in Qatar. "Liquefied natural gas is an important energy source with Qatar playing a very dominant role in this area," Mannan said. "This is an important aspect that Qatar needs to be concerned about."

Mannan offered encouragement to Texas A&M at Qatar engineering students, suggesting they become involved in research opportunities at the University.



Dr. Holste and Dr. Mannan

"For students to see first-hand how LNG behaves under these special circumstances is very important in a chemical engineering education," he said. "I would encourage students studying chemical engineering to get directly involved in the actual research or at the very least, go on a field trip."

Invited Lecture at WPI

Dr. Mannan was invited in February to give a lecture in the Chemical Engineering Department at Worcester Polytechnic Instituteas part of their 2009/2010 Departmental Seminar series.

For this seminar series, distinguished members of the academic and industrial community are invited to present their views and thoughts on contemporary issues that dominate public discourse in the field of chemical engineering. Entitled, "Lessons Learned From Past Incidents Shed Light on Present Day Needs and Challenges In Process Safety," the presentation discussed present day needs and challenges in process safety and provided a framework where industry, government, academia and other stakeholders can work together to reduce the probability of occurrence and the consequences of such catastrophic incidents. The presentation was followed by day of visiting with other researchers and members of their department to find ways to collaborate and bring process safety issues to the classroom.

26L VESSEL DUST EXPLOSION EQUIPMENT

By Diana Castellanos

Numerous dust explosion incidents over the past years have raised serious concerns about combustible dust hazards in dust handling industries. Due to the complexity of the dust explosion phenomena, theories about dust explosions and methods for the prevention of dust explosions are still insufficient. Therefore, comprehensive research in this field is needed. The 26L dust explosion equipment and results obtained from this study can be useful to understand the risks in more detail to prevent recurrence of dust explosion in accidents.

The 26L dust explosion equipment was donated by The Dow Chemical Company to the Mary Kay O'Connor Process Safety Center in 2008.

DUST EXPLOSION EQUIPMENT

The following photographs show equipment status in

April 2008:



Most of the components attached to the vessel were rusted and therefore were removed. A Hydrotest was performed in order to verify equipment robustness at high pressures.

This equipment has the following differences as compared to standard dust explosion equipment:

26L instead of 20L vessel Bigger size \rightarrow

Different Shape → Non spherical shape

CURRENT SYSTEM STATUS

The system was designed following ASTM standards E-1226-05 and E-1515-07.





3. SYSTEM CAPABILITIES

The test results that can be obtained from 26L vessel are listed as follow:

Property	Definition	ASTM Test Method	Application
P _{max}	Maximum explosion over- pressure generated in the test chamber	ASTM E 1226	P_{max} is used to predict the severity of the explosion. Additionally it is used to design vessels.
(dP/dt) _{max}	Maximum rate of pressure rise	ASTM E 1226	Predicts the violence of an explosion. Used to calculate K_{St} .
K _{St}	Dust deflagration index	ASTM E 1226	${\sf K}_{\sf St}$ is used to classify dust based on their explosibility.
MEC	Minimum explosive concentration	ASTM E 1515	Measures the minimum amount of dust (dispersed in air) required to produce an explosion. MEC is analogous to the lower flammability limit (LFL) for gas/air mixtures.
LOC	Limiting oxygen concentration	ASTM standard under development	Determines the least amount of oxygen required to produce and explosion.

Table 1. Test results that can be obtained from 26L vessel. Adapted from [1][2]¹

Deflagration Index (K_{St}): is a volume normalized rate of pressure rise and is expressed by the cubic law. It relates the maximum rate of pressure rise to the volume of the vessel in which the explosion occurs.

$$K_{St} = \left(\frac{dP}{dt}\right)_{max} V^{1/3}$$

V is the volume of the test chamber [m^3]. Combustible dusts are classified by their K_{St} values in increasing order of explosion violence as follows (Bartknecht, 1989):

• $K_{St} = 0$	=Group St0: non-explosive	1
• $0 < K_{St} \le 200$	=Group St1 weak	Increasing
$\bullet 200 \le K_{St} \le 300$	=Group St2 strong	Explosibility
• $K_{St} > 300$	=Group St3 very strong	+

4. EQUIPMENT DETAILS

Control system: LabView (National Instrument Inc.) is used control the interface.

Calibration: Mary Kay Connor Process Safety Center will be involved in a round robin test³ to evaluate the repeatability and reproducibility of the results obtained with the 26L dust explosion equipment.

¹ [1]Dastidar, Ashok Ghose, et. al., 2005. "Evaluation of Dust and Hybrid Mixture Explosion Potential in Process Plants," Process Safety Progress. Vol. 24, No. 4, December 2005.

^[2] Shelley, S. Update Preventing dust explosions. March 2008 CEP

[†] Bartknecht, W., Dust Explosions. Course, Prevention, Protection. 1989, New York: Springler-Verlag Berlin Heidelberg. 56-80

[‡] Round Robin Test: It is a test performed independently several times. It involves multiple independent scientists performing the test with the use of the same method in different equipment. Cesana, C. (2004) Final report. Calibration-Round-Robin CaRo 03, Report no. B052 185, Adolf Kühner AG, Birsfelden, Switzerland

The 2nd JNIOSH International Workshop/Seminar for Occupational Safety and Health Promotion

"International Trend of the Control of Major Accidents in Chemical Plants"

Dr. Mannan was invited to speak in December as an expert on the topic of major accidents in chemical plants. The objective of this meeting was to bring two experts—one from the US and one from Europe to report the recent trends of risk assessments. Mr. Yutaka Maeda, Director of JNIOSH, opened the meeting with welcoming remarks to all participants. After the two presentations, discussion was opened up to government and industry representatives from Japan.



Below is the abstract of Dr. Mannan's presentation and seminar:

"Globalization introduces challenges to every aspect of our lives. In the industrial safety arena, globalization introduces significant challenges, among other reasons, due to the diversity in defining what is consider "safe" and what the appropriate level of tolerability to risk is. These concerns with globalization processes become even more significant due to the high level of uncertainties associated when there is a need to balance between safety and other competing operational goals.

Among the current initiative to address the challenges above are the Globally Harmonized System for the Classification and Labeling of Hazardous Chemicals project, and the development of a system known as the Mutual Acceptance of Data (an assessment of chemicals which saves human and animal resources by harmonizing approaches to testing chemicals for safety).



It is well recognized that successful economic programs of individual nations can not be established without incorporating international trends into these programs. While the initiatives above are first steps in the right direction to add international domain to the manufacturing/processing chemicals, there is a need to build a coherent frame work to address diversity challenges to the process safety arena."



Dr. Maddison and Dr. Mannan

The other speaker regarding the European experiences was Dr. Tom Maddison. Dr. Maddison is the HM Principal Specialist Inspector, Hazardous Installations Directorate, Major Hazards and Risk Assessment Unit, Health and Safety Executive (HSE), UK. His talk was entitled, "The Control of Major Accidents in the Chemical Industry - European Legislation and the Use of Appropriate Risk Assessment Techniques."

Link: http://ioshic.web.fc2.com/seminar/20091210_2nd_seminar_e.html

65th Annual Instrumentation Symposium, Success Continues for this long-standing conference

Keeping up with the latest software, knowledge and regulations as they affect the instrumentation world is what brings professionals, students and staff together every year in January. They come to this long-standing symposium because it provides a venue for technical presentations, workshops, networking and exhibits offering the latest in technology for the industry.

The 65th Annual Instrumentation Symposium for the Process Industries was held on January 26-28, 2010 at the Rudder Theatre Complex. The symposium was hosted by the Center and Texas A&M's Artie McFerrin Department of Chemical Engineering.

In the presentation by Mr. Jerry Bradshaw, symposium chair and senior lecturer in the Artie McFerrin Department of Chemical Engineering entitled, *History of Instrumentation* he stated,

"I am not an instrument or control systems engineer, but I am a chemical engineer and have used instrumentation that spans over 70 years of technology."

His summary of the history of how this instrumentation symposium has evolved and the topics spanned over years emphasizes why it is important to keep current with the industry practices and where the future lies ahead. "With the advent of the bus technology, where do we go next? How much wireless is in our future?" Bradshaw notes that these topics will come into our future program as we continue to answer these questions and many more in this continuous changing industry.

The Keynote address was given by Ian Nimmo, President and Founder of User Centered Design Services, Inc. Mr. Nimmo has over 25 years experience and knowledge as an electrical designer, instrument/ electrical engineer, and computer applications manager. For the last 20 years, he has had extensive experience

in computer control safety as it affects batch control and continuous operations.

Mr. Nimmo spoke on Safety & Automation System (SAS) – How the Safety and the Automation Systems finally come together as a HMI. He explained how the control room design and new technology can bridge together so that operators and instrument engineers can understand how these systems fit in the big picture. He states how there are clear guidelines on how the Safety Instrumented Systems (SIS) and Basic Process Control Systems (BPCS) should be separated from a controls network perspective. How does this affect the HMI and the control room design? Today's best practices for bringing these "islands" of technology together will be key in making human error minimal.

The symposium featured 40 exhibits from firms showcasing their software products, instrumentation goods and safety instrumented systems. Exhibits provided an opportunity for managers, operators, students and instrumentation personnel to view, network and seek out new trends and technology that is available to them in their respective areas.

Workshops were conducted each day and addressed a wide variety of topics, including ethics, securing control systems, and total plant wireless. These workshops offer continuing education units (CEUs) and professional development hours (PDHs) that are nationally recognized and designed to provide a record of training and continuing education for those who hold professional engineer licenses.

The 66th Annual Instrumentation Symposium is scheduled for January 25-27, 2011, visit http://instrumentation-symposium.che.tamu.edu. Call for Papers are being solicited through April 30th, see the website for topics of interest and an abstract template form.

For more information on the annual Instrumentation Symposium at Texas A&M, contact: Mary Cass, symposium coordinator, at 979.458.1863 or via email: mary-cass@tamu.edu or Jerry Bradshaw, symposium chair, at 979.845.0610 or via email: j-bradshaw@tamu.edu.



Safety Engineering Courses Fall 2010

The Mary Kay O'Connor Process Safety Center (MKOPSC) is offering the following safety education and process safety engineering courses in Fall 2010, via the Petroleum Engineering Department's Distance Learning Program.

These distance learning courses are eligible for academic credit or Continuting Education Units (CEUs). To receive academic credit for the courses, you must be a currently enrolled student at Texas A&M University. The courses also apply towards the Safety Engineering Certificate.

Fall 2010 Offerings

SENG 310 - Industrial Hygiene Engineering

Instructor: Dr. Dedy Ng

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 – SENG 455: Process Safety Engineering

Instructor: Ray Mentzer

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

Instructor: Dr. William J. Rogers

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.

To register for a course, contact:

Mary Cass

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: mary-cass@tamu.edu

Distance Learning Objectives

In the future, the Center plans to offer all courses online for the Safety Engineering Program and the Safety Engineering Certificate Program, to teach the knowledge and skills required for safety, health, and environmental engineering.

Also in future plans is the ability to offer the Masters of Engineering in Process Safety and Masters in Safety Engineering programs as distance education programs. The objective of the non-thesis Masters of Engineering in Process Safety (ME-PS) program is to teach the principles and practices of process safety engineering for leadership careers in the process safety. For more information on requirements and prerequisites, please see website at:

http://psc.tamu.edu/education/safety-engineering-program

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

Case Histories

Barton Solvents - Static Spark Ignites Explosion Inside Flammable Liquid Storage Tank

Presented by Victor Carreto Vazquez at the January 13, 2010 Steering Committee Meeting.

This case study summarized the investigation carried out by the CSB about the fire and explosion that occurred at Barton Solvents on July 17, 2007. Barton Solvents is a small family-owned company, which is a stocking wholesale distributor of industrial chemicals, oils, surfactants, and plasticizers. The facility involved in the incident, located in Valley Center, Kansas, was used to store flammable substances. As a direct consequence of the incident the storage tanks were completely destroyed, 11 residents and 1 firefighter had to receive medical attention, and 6,000 residents of Valley Center were evacuated.

The most likely cause of the accident was the ignition inside a Varnish Makers' and Painters' (VM&P) naphtha due to an electrostatic discharge. A hazardous static electricity build up occurred in the non-conductive liquid inside a VM&P storage tank during loading operations from a tanker trailer. A spark originated in the loose flexible linkage assembly, which was part of the liquid level gauge ignited the flammable mixture above the liquid level and initiated the incident.

This case study shows how static electricity still represents a frequent ignition source when flammable liquids are handled and processed in different branches of the process industry. CSB recommendations pointed out the need to improve the MSDS to inform about the hazards due to static electricity accumulation and to include the safety measures to reduce these hazards.

Reactive Chemical Explosions: A Case Study from the T2 Laboratories Explosion

Presented by Philip Hodge at the March 11, 2010 Steering Committee Meeting.

On December, 19th, 2007 at 1:33 pm, T2 Laboratories, Inc of Jacksonville, FL experienced a powerful explosion and subsequent fire when a loss of cooling led to a runaway reaction. The incident resulted in 4 deaths, 32 injuries, and extensive property damage. The incident occurred during the batch production of methylcyclopentadienyl manganese tricarbonyl (MCMT) – a three step process. During the first process step which produced hydrogen gas as a byproduct, an exothermic reaction was controlled by a water cooling sleeve around the reactor to keep the reaction between 300°F and 350°F. When the cooling sleeve failed to fill, due to an unknown failure, the reaction reached a second exothermic potential. This led to an uncontrollable temperature and pressure accumulation resulting in an explosion. Solvents and other chemicals on site were ignited, and firefighters fought the blaze until December 21st.

The CSB investigation found that several factors contributed to the explosion at T2 Labs. The first was lack of proper safety testing procedures during scale up from lab tests to production. They also found that the water cooling system was subject to a single point failure and was not properly inspected and maintained. Finally the CSB found that the owners and operators at T2 were unaware of the potential for runaway reactions in their process and were poorly trained in safety best practices. As a result of this incident, the CSB has recommended that the American Institute of Chemical Engineers and the Accreditation Board of for Engineering and Technology Inc. work together to increase the number of chemical engineering programs that mandate process safety education, especially where it concerns reactive chemicals, as part of their degree plan.

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Mary Kay O'Connor Process Safety Center

2010 INTERNATIONAL SYMPOSIUM Making Safety Second Nature

October 26-28, 2010 Hilton Conference Center College Station, Texas







Qualifies for 15 PDHs required by Texas Board of Professional Engineers, when taken with the 1 hr Engineering Ethics session immediately following the Symposium. See website for registration information on the Special Session: Engineering Ethics.

Online Registration is available on-line at

http://psc.tamu.edu/symposia/2010

Exhibit space is also available. Please see the website for more information and online reservations, or contact donnas@tamu.edu or 979/845-5981.



Mary Kay O'Connor PROCESS SAFETY CENTER

Making safety second nature.

2010 Continuing Education Schedule

http://psc.tamu.edu/events/2010-schedule-of-classes

	Date	Class	Instructor	Location
	1/14 – 1/15	OSHA PSM & NEP Training	Siemens staff	Phoenix Contact
	2/2 – 2/3	Fundamentals of Process Safety Management	Sepeda	Phoenix Contact
	2/4	Management of Change	Sepeda	Phoenix Contact
	2/9 – 2/10	Process Hazard Analysis Leadership Training	Early	Phoenix Contact
	2/16 – 2/18	SISImplementation	Summers	SIS-TECH
	3/2 – 3/3	Best Practices – Pressure Relief Systems	Aldeeb	Phoenix Contact
	3/16 – 3/17	SIL Verification	Summers	SIS-TECH
	4/6 – 4/7	Layer of Protection Analysis	Summers	SIS-TECH
	5/11 – 5/13	SISImplementation	Summers	SIS-TECH
	8/17	Reactive Chemical Hazards Assessment	Rogers	Phoenix Contact
	8/24 – 8/25	Best Practices – Pressure Relief Systems	Aldeeb	SIS-TECH
	8/24 – 8/25	Dust Explosion	Emerson	Phoenix Contact
	8/31 – 9/1	Fundamentals of Process Safety Management	Sepeda	SIS-TECH
	9/2	Management of Change	Sepeda	SIS-TECH
	9/14 – 9/15	Process Hazard Analysis Leadership Training	Early	TTI
	9/21 – 9/23	SISImplementation	Summers	SIS-TECH
	10/5 – 10/6	SIL Verification	Summers	SIS-TECH
	10/20	Best Practices – Fluid Transfer Solutions	Thurman/Lingo	Phoenix Contact
	11/2 – 11/3	Layer of Protection Analysis	Summers	SIS-TECH

Available upon request				
Implementing or Optimizing Your SHE Management Systems	McVaugh			
Auditing your SHE Management System	McVaugh			
Fundamentals of Loss Prevention	Slye			
Inherently Safer Design	Moore			
Liquefied Natural Gas	Mannan			
Engineering Design Systems	MKO Staff			
What Went Wrong?	Sanders			

Locations

SIS-TECH Solutions - 12621 Featherwood; Houston, TX
Phoenix Contact Customer Technology Center – 3993 W. Sam Houston Pkwy, Suite 500; Houston, TX
Texas Transportation Institute – 701 N. Post Oak, Suite 430; Houston, TX

Mary Kay O'Connor Process Safety Center Texas A&M University College Station, TX 77843-3122 Phone: 979.845.3489 Fax: 979.458.1493 Email: mary-cass@tamu.edu http://process-safety.tamu.edu

EXHIBIT AT THE

2010 Symposium Making Safety Second Nature

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October 28-29, 2008
Hilton Conference Center
College Station, Texas



\$1250 includes:

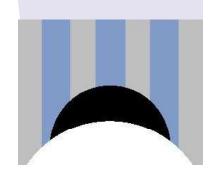
- one Symposium registration
- listing in meeting programs (in print and on-line)
- 10'X8' booth space
- electrical hookup
- skirted table/2 chairs

Register online at:

http://psc.tamu.edu/symposia/2010

For more information contact Donna Startz at phone: 979-845-5981 or email: donnas@tamu.edu

Mary Kay O'Connor Process Safety Center





Center at a Glance

Areas of Research

Student Data & Center Statistics

Database Analysis

Process Design

Chemical Reactivity
 Risk Metrics

Risk Assessment

Gas Leak Detection

Vapor Dispersion

Aerosol Flammability

Flammability

• Chemical Process Resilience

Dust Explosion

HOT TOPICS

Facility Siting

• LNG

Fire Suppression

Tents

Current Students – MS – 7

Current Student - PhD - 22

Visiting Students -10

Graduated Students - 47

Graduate Fellowships - 1

Undergrad Scholarships - 17

Research Staff - 8

Faculty Fellows - 15

Refereed Publications - 123

Research Awards - \$1 Million

Research Expenditures – \$2.1 Million

CALENDAR

April 29, 2010

MKOPSC Steering Committee Meeting

Location: Huntsman, The Woodlands, TX

April 30, 2010

MKOPSC Technical Advisory Committee Meeting

Location: Huntsman, The Woodlands, TX

October 26-28, 2010

2010 SYMPOSIUM

Mary Kay O'Connor Process Safety Center

College Station Hilton Conference Center

Contact:

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