2001 Symposium Provides Forum for Research

The Mary Kay O’Connor Process Safety Center hosted the 2001 Annual Symposium on October 30-31, 2001, at the Reed Arena in College Station. This was the 4th in the series of successful symposiums hosted annually by the Center. Symposium attendees came from all over the United States as well as from overseas, some as far away as from Japan, Poland, and Russia.

Mr. Roy Sanders gave the opening presentation based on the paper “Some Problems and Opportunities That Have Been Overlooked,” by Dr. Trevor Kletz. The Kletz paper summarized the need for a system to control changes in organization, that we can learn from the experience of other industries without waiting for similar accidents to occur in our own company or industry, and that eliminating a hazard or improving the design is usually more effective than improving procedures (though not always possible).

Dr. Sam Mannan, Center Director, presented the “State of the Center” address. He said, “the Center continues to make major strides in developing and implementing education, research, and service programs dedicated to improving safety in the industry.”

The papers presented at the Symposium represented a unique combination of practical applications and findings from research advances.

Mr. Abdulrehman Aldeeb of the Mary Kay O’Connor Process Safety Center presented a paper entitled, “Theoretical and Experimental Techniques for the Evaluation of Reactive Chemical Hazards.” Aldeeb said that evaluation of reactive chemical hazards is critical for the design and operation of safer chemical plant processes. Much effort is needed for experimental techniques to measure thermal reactivity of chemical systems. Studying all the various reaction pathways experimentally however is very expensive. Therefore, it is essential to employ simplified screening tools to reduce the number of experiments and to identify the most

(Symposium, Continued on Page 9)
The events of September 11, 2001, have had a profound effect on all of us. It is therefore appropriate that I address some issues that I feel are pertinent with regard to common interests as well as process safety. First, I feel that it is very important that we return to business-as-usual. This is even more important for the economy in this day and age of intertwined financial dependence. Second, the events of September 11 and later have also caused significant distraction and competition for “energy”. By competition for energy, I mean that while attention to security issues is essential, we must also continue to give the same attention to our routine and regular safety and engineering activities. Third, we need to use the aftermath of this terrible event as an opportunity for redoubling our effort for making our plants inherently safer. I firmly believe that an inherently safer plant is also a more secure plant. However, there are a number of challenges to implementing inherently safer design and concepts in existing as well as new plants.

Proposed legislation now being considered in the Senate calls for improvements in inherent safety to reduce the potential risk from terrorist activities. While improvements in inherent safety are desirable, it is likely that such efforts will require years to develop and implement and may be very costly. Consideration must also be given to existing plants and developing new technologies.

Inherently safer processes, design, and equipment are best addressed during the earlier stages of the plant’s life cycle. In fact, if inherently safer issues are not addressed during the conceptual design phase and in some cases the process chemistry phase, the battle may well be lost. Thus, the challenge I want to put forth is two-fold. First, how can we incorporate inherently safer aspects in existing plants without putting industry out of business? Second, how can we make sure that inherently safer concepts are given the fullest consideration during the process chemistry and conceptual design phase for new plants?

Often it is difficult to determine whether a proposed change to improve inherent safety will actually accomplish that goal. It is similarly difficult to determine what is the most economical method of achieving an improvement in inherent safety. For example, consider the costly retrofitting of an alkylation process in an existing refinery by substituting hydrogen fluoride for sulfuric acid. Instead, options such as addition of inhibitors to the hydrogen fluoride in addition to installation of mitigation devices such as water curtains may afford a comparable reduction of hazard potential at far less cost. Another issue is that it requires a much larger quantity (by several orders or magnitude) of sulfuric acid for the alkylation process as compared to hydrofluoric acid. Thus, by making the substitution, we are buying into other risk management issues, such as the transportation and storage of larger quantities of sulfuric acid. Whether or not the substitution of hydrogen fluoride for sulfuric acid reduces the overall risk must be determined on a case-by-case risk assessment. The risk assessment would consider specific issues relevant to the site, process, transportation routes, surrounding population, and other factors. Thus, implementing inherently safer options on existing plants may be easier said than done and must consider the entire process of manufacture, storage, transportation, and use of alternative technologies as well as the economics of such changes. Our society will be challenged to answer what level of risk do we accept and what costs are we willing to accept to achieve that level of safety?

Ensuring consideration of inherent safety during the process chemistry and conceptual design phase for new plants is somewhat different. First, the individuals involved in these phases may not be involved in the latter phases of the plant’s life cycle and thus may not be aware of the potential significance of their decisions with regard to the inherent safety of the plant after it is built and in operation. Second, in many cases, it is quite difficult to look at the process chemistry and be able to visualize what the scaled-up version of the plant would look like and thus be able to visualize the potential inherent safety problems.

During the design phase there is often too little time to thoroughly consider all alternative process schemes, materials substitutions, etc. In many cases significant and time consuming research may be required to develop inherently safer processes. Once the economic conditions exist to justify building a plant, time is of the
2001 Merit and Service Awards

The Mary Kay O’Connor Process Safety Center’s Merit Award recognizes an individual who has made significant contributions to the advancement of education, research, or service activities related to process safety concepts and/or technologies. The contributions or accomplishments leading to the annual Merit Award need not be associated with the Center but must fit within the central theme of the Center, i.e., Making Safety Second Nature. In establishing the Merit Award, the Steering Committee underscored the importance of promoting and recognizing significant contributions and accomplishments of practitioners and researchers worldwide. According to Steering Committee Member Michael O’Connor, “Accomplishments in process safety must be recognized and promoted so that practitioners and researchers not only feel excited and committed to the new developments, but also the recognition will help disseminate and publicize the ideas and work accomplished by the individual receiving the recognition. The celebration of process safety accomplishments will hopefully be another catalyst in improving process safety in the process industries.”

The Service Award established by the Steering Committee honors and recognizes individuals who have contributed directly to the success of the Center and have played a significant role in advancing the mission of the Center. Nominations for either award should be sent to the Center Director by April 30 each year. Based upon the nominations received, the Steering Committee makes the final selection. Awards are presented during the general session of the Annual Symposium. Dr. Roland Haden, Vice Chancellor of Engineering at Texas A&M University presented the 2001 Merit and Service Awards during the opening session of the 2001 Symposium on October 30, 2001. The 2001 Merit Award was presented to Mr. Jim Makris. Mr. Makris oversees the development and implementation of all EPA chemical accident preparedness and prevention programs. His leadership to reduce chemical accidents and environmental risks has included a vital role in implementation of the Clean Air Act Section 112(r), which includes provisions for industrial facilities to develop and implement plans for managing chemical risk associated with their operations. He has served 10 years as chair of the National Response Team, encompassing 15 federal agencies, and is co-chair of the US/Mexico and US/Canada Joint Response Teams. He helps ensure worldwide collaboration on chemical emergency prevention and preparedness with European and other international organizations. In presenting the Merit Award Dr. Haden said that, “By selecting Mr. Makris for this award, the Steering Committee is recognizing a lifetime of commitment and hard work for chemical safety, emergency preparedness, and prevention programs. We hope that the recognition of his accomplishments will further disseminate and publicize his ideas and work.”

The 2001 Service Award was presented to Ms. Irene Jones. Ms. Jones has 25 years experience in the chemical and petroleum industry. She currently manages process safety and risk management programs for Huntsman. She is a member of the American Chemistry Council’s Process Safety Task Group in support of implementing the Process Safety Code of Responsible Care®. She is a former chair and member of the Texas Chemical Council’s Safety Committee. She is a contributing author to the American Chemistry Council publication “A Manager’s Guide to Managing Process Change” as well as contributing author for other industry standards and guidance documents. In presenting the Service Award Dr. Haden said that, “Ms. Irene Jones has given of her time, advice, and support freely to the Center. We are pleased today to recognize her contributions and accomplishments.”
On the other hand if economic conditions do not exist for the construction of new plants for a certain product, there is little economic incentive to pursue such research and development.

Other changes toward inherent safety may also require changes in the industries infrastructure to process, transport, store, and use substitute materials or processes.

Given the uncertain economics and long-term nature of these challenges, it may be appropriate for government agencies and industry groups to sponsor research and development of inherently safer designs for new and existing processes. Priority research areas could be determined with a risk-based analysis based on information such as the worst case scenarios in the EPA RMP.

Finally, I want to address the dangers associated with making risk information widely available. Arguments have been made that this type of risk information could be used for evil purposes. That argument may very well carry the day given the current national mood and circumstances. Improvements in chemical safety are dependent on many factors, some of them quite complex. One of these factors, I believe is public trust. The more the public trusts the government and the industry, the greater the community interaction, which I believe fosters dialogue for inherent safety and emergency preparedness, the net effect being contributions to safety improvements.

(My name is Lizbeth Cisneros. I graduated from the Monterrey Institute of Technology (ITESM; Monterrey, México) with a BS in Chemical Engineering and Management on December 1994. I worked in industry for 2.5 years before being granted a Fulbright Scholarship to pursue my PhD in Chemical Engineering at Texas A&M University.

I have really enjoyed my graduate studies here. Prior to coming to Texas A&M, I had visited other countries as a tourist, but I never had the opportunity to work and interact with people from other cultures. This experience of working with students from other countries has been enriching for me. I have learned much about tolerance, diversity, and mutual respect for diverse ideas. I have also learned that there are other delicious dishes besides tacos.

Working for the Mary Kay O’Connor Process Safety Center has given me the opportunity to interact with people from industry and perform very practical research. I really enjoy the fine people working with me in the Reactive Chemical Group, and I think that we together can make significant contributions to Process Safety.

Research: Adiabatic Calorimetric Studies of Hydroxylamine Compounds

Today’s chemical processes require higher pressures, higher temperatures, and new substances as raw materials. Routinely, the process reaction is well documented before initial plant start-up. Unfortunately side or decomposition reactions are often overlooked.

My research uses fundamental thermodynamics, kinetics, heat, and mass transfer with adiabatic calorimetry principles to study the thermal decomposition of hydroxylamine/water 50 wt.% and some of its derivatives. The effects of metal contaminants, e.g., stainless steel, and carbon steel, in the overall decomposition reaction rate are being analyzed. The thermokinetics of the respective systems are modeled using the heat generation rates. From such kinetic models, reaction orders, activation energies, and frequency factors for the overall decomposition reactions are obtained. The kinetic parameters are used in computer simulations to obtain models for the temperature vs. time curves.

(Director’s Corner, Continued from Page 2)
By summer 2002, Texas A&M will join the ranks of e-commerce sites around the world, but instead of music or books, students will be browsing, registering, and paying for continuing education courses online.

Administrators at Texas A&M consider e-commerce to be one of the key components of a 21st century continuing education system. With the college degree being the basic qualification for employment, competence—not just credentials—means more than ever to the US workforce. Members of A&M expect increasing demand for applications of the university’s ongoing, cutting-edge research in a business-oriented continuing education program. When complete, A&M’s e-commerce web site will offer one easy clearinghouse for browsing continuing education offerings, registration, and payment.

Texas A&M’s Mary Kay O’Connor Process Safety Center already offers off-campus continuing education courses in Houston. Elizabeth Tebeaux, Director of Distance Education at Texas A&M, sees continuing education by distance as a major growth area for the university. “We have ten graduate programs available by distance, and departments hosting these programs are looking for ways to package key modules of these programs for continuing education delivered over distance. With flexible delivery, companies and students can benefit.”

According to Tebeaux, working adults place a high value on easy access when “shopping” for the supplemental knowledge needed to keep current and competitive in their fields. “That’s why, over time, you will see more education available off-campus in formats that are convenient to the student, such as on-site classes at companies, interactive video, and web-based instruction.”

Communication technology from the last decade has given companies and individuals greater choice about how and when they access continuing education. Web-based instruction in particular allows students to access coursework when they have time to pursue it.

Planners at Texas A&M expect that individuals will use the proposed website to find, register, and pay for courses, while college departments will continue to work with companies to develop programs tailored to meet their needs.

“TAMU has not been a major player in the continuing education market, but that is changing,” Tebeaux says. “This university is moving to meet the new demand for life-long, continuing education.”

RECENT PUBLICATIONS


The Mary Kay O’Connor Process Safety Center has unveiled its 2002 continuing education catalog of process safety and risk assessment courses. The 2002 catalog features the addition of several new courses in addition to the existing popular courses. A detailed schedule of courses from the 2002 catalog is provided on the following page.

On many occasions, companies have requested that a continuing education course be tailored to their needs and be offered specifically for their employees or a particular work group. Onsite courses can be made available and have proven to be very successful. The instructor travels to the facility thus eliminating travel time and costs for the facility employees. In addition, the short course is tailored to the specific needs of the facility. The opportunity presents a win-win situation where the course is tailored to the specific company needs, the instructor travels to the facility location, and can teach to an audience as small as eight or up to 20. For more information and contract arrangements for an onsite course, please contact Ms. Mary Cass at (979) 458-1863 or by e-mail at mary-cass@tamu.edu.

Mary Kay O’Connor Process Safety Center
Continuing Education Registration Form

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Registration and Fees:

Early Registration  - $395.00 per person
Regular Registration - $450.00 per person

Circle one: [ ] American Express [ ] Diners Club [ ] MasterCard [ ] Visa

Total $ __________________

Please send registration form and check (made payable to the Mary Kay O’Connor Process Safety Center) or fax registration if paying by credit card (American Express, Diners Club, MasterCard, or Visa) to:

Mary Kay O’Connor Process Safety Center
Attention: Mary Cass
Texas A&M University
3574 TAMU
College Station, TX 77843-3574
Phone: (979) 458-1863  Fax: (979) 458-0422
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<td>5 - 6 · Best Practices: Pressure Relief Systems - Pat Berwanger</td>
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<td>12-13 · Systematic Assessment of Reactive Chemical Hazards - Sam Mannan and Bill Rogers</td>
<td>9 -10 · Comprehensive HSE Management for Small and Medium Sized Businesses - Bill Effron and Chris Paul</td>
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<td>19-20 · Process Safety Management - Sam Mannan</td>
<td>16-17 · Best Practices: Process Safety Information Management - Pat Berwanger</td>
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<td>16-17 · Engineering Design Practices for Safet Process Plants - Stanley Grossel and Rudy Frey</td>
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<td>27- 28 · Management of Change - Steve Emererson</td>
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<td>21-22 · Serious Incident Prevention - For Operating Managers and Safety Professionals - Thomas Burns</td>
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<td>1 - 2 · Understanding and Preventing Fires and Explosions in Petrochemical Plants - Gary Pilkington</td>
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<td>24-25 · Serious Incident Prevention -- For Operating Managers and Safety Professionals - Thomas Burns</td>
<td>8 - 9 · Process Hazard Analysis - Skip Early</td>
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<th>November</th>
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<td>5 - 7 · ISA8401-Application of Safety Instrumented Systems for the Process Industry (extended version) - Charles Hardin</td>
<td>10-11 · Understanding and Preventing Fires and Explosions in Petrochemical Plants - Gary Pilkington</td>
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**Locations:** TEEX Training Facility or IBT Facility, Houston, TX  
**All classes run:** 9:00AM - 4:00PM  
**Registration Fees:**  
Early Registration (4 weeks prior) - $395.00 per person  
Regular Registration - $450.00 per person
CALL FOR PAPERS

MAKING SAFETY SECOND NATURE

SYMPOSIUM
October 29-30, 2002

Sponsored by
Mary Kay O’Connor Process Safety Center
Chemical Engineering Division, Texas A&M University System

Topical Areas - This symposium focuses on present and future areas of research and activity at the Center

- **National Chemical Safety Assessment Project** – Zero Vision, Trends, Data Sources and Repository, Public Trust and Interaction
- **Risk Assessment** – Quantitative Analysis, Case Studies, Reliability Data
- **Reactive Chemicals** – Predicting Reactivity, Role of Contaminants, Catalysts and Inhibitors, Case Histories, Experimental Methods
- **Aerosols and Dispersion** – Formation, Rain-Out, Flammability, Computational Fluid Dynamics
- **Learning from Incidents** – Databases, Investigations, Trends, Causes and Patterns
- **Inherent Safety** – Measuring, Design Methods, Case Studies
- **Process Management for Safety** – Benchmarking, Indicators of Plant Health, PSM Elements
- **Process Control** – Abnormal Situations, Detection and Recovery, Safety Instrumented Systems
- **Ammonia, Chlorine, and Propane Incidents** – in SMEs, Storage, Transportation, Refrigeration, Water Treatment
- **Electrostatic Hazards** – Climate Regions, Problem Fluids, Containers and Storage
- **Fire Protection Engineering** – Ignition and Flame Spread, Flammability, Structural Fire Protection, Fire Hazard Analysis

Abstracts are due no later than March 1, 2002
Send abstracts to Dr. Sam Mannan, e-mail: mannan@tamu.edu
Ph: (979) 862-3985, Fax: (979) 458-1493
Chemical Engineering Department, Texas A&M University
College Station, Texas 77843-3574

Additional information available on internet at [http://process-safety.tamu.edu](http://process-safety.tamu.edu)
Exhibition space for displaying equipment, software, and materials is available. For further information on exhibition space, contact Ms. Donna Startz (donnas@tamu.edu) (979) 845-3489
energetic pathways. In his paper, Aldeeb proposed a systematic approach for the evaluation of reactive chemical hazards. This approach is based on a combination of numerical computational methods and experimental thermal analysis techniques. Numerical computational methods are used to predict reaction stoichiometries, thermodynamics, and kinetics, which help to exclude thermodynamically infeasible and non-hazardous reaction pathways. Finally the method proposes that experimental techniques be used to evaluate the most energetic systems for more accurate thermodynamic and kinetics parameters or to replace failed numerical methods.

Dr. Adam S. Markowski of the Technical University of Lodz presented a paper entitled, “Quantitative Risk Assessment for the Refinery Industry.” Markowski said that a quantitative risk assessment is a widely accepted method for safety assurance in the process industry. The method is improved continuously by introduction of new approaches both to hazards identification and risk evaluation. The paper addresses two important aspects:

- Selection of creditable incidents after qualitative hazards identification that subsequently are used in individual and group risk evaluation.
- “Domino effects” understood as a subsequent chain of accidents after a single hazard event.

The first aspect is developed by the application of multilayer risk matrix where each layer represents risk reduction level according to typical prevention, protection, and response layers met in a particular refinery installation. The second aspect is presented by guidelines on a particular chain of events occurring for the most common refinery types of the equipment (storage tanks, loading and unloading areas, reactors, pipe networks and other types of process equipment). The above aspects are illustrated by the case study of a HF Alkylation Plant.

Dr. Angela Summers of SIS-Tech Solutions presented a paper entitled, “Bridging the Safe Automation Gap.” Industry is rapidly approaching the 10th anniversary of the OSHA Process Safety Management regulation. This regulation requires the use of generally accepted good engineering practices as demonstrated by a series of industrial standards and guidelines. The OSHA PSM program was intended to make the chemical process industry safer, but catastrophic incidents continue to occur in spite of PSM implementation. A significant portion of the safeguards installed to reduce the frequency of catastrophic incidents relies on automation, including process control, operator alarms and responses, safety instrumented systems, emergency isolation and venting, and fire and gas systems. In her paper, Summers demonstrated that significant safe automation gaps, which have been identified during audits of chemical, petrochemical, and refining units, represent missed opportunities for improving and maintaining the safe operation of these units.

Dr. Arcady Kossoy of ChemInform, St. Petersburg presented a paper entitled, “From Experimental Data via Kinetic Model to Predicting Reactivity and Assessing Reaction Hazards.” Kossoy said that there is no other way to get original data regarding chemical reaction but experimental study. The experimental technique used depends on the aim of a study. Nevertheless, there is one almost universal method that is particularly applicable in such areas as predicting reactivity, assessment of reaction hazards, thermal stability of chemicals, etc. This is calorimetry of various types (DSC, isothermal, reaction, adiabatic etc.). Very often calorimetry is used for direct experimental determination of necessary characteristics. At the same time, introduction of mathematical simulation can lead to much more versatile and reliable results in combination with more complete use of information contained in experimental data. The approach to investigating a chemical reaction and predicting its behavior under various conditions, which systematically uses kinetics-based simulation, is
the subject of the paper. Kossoy showed several examples demonstrating the efficiency of the approach. The following cases were discussed:

- Predicting the adiabatic course of a reaction using DSC and adiabatic data
- Analyzing thermal stability of a product, influence of product’s composition, and presence of contaminants
- Determining reactivity rating number of a chemical product
- Determining critical parameters of thermal explosion
- Simulating runaway in a BATCH and vent sizing
- Designing an inherently safer process

Mr. Bob Perry of the Center for Chemical Process Safety, American Institute of Chemical Engineers presented a paper entitled, “If You Can’t Measure It, You Can’t Control It: ProSmart, Process Safety Management.” Perry said that the purpose of ProSmart is to help companies identify and use qualitative and quantitative indicators of the performance of PSM Systems to aid in continuous improvement. Continuous improvement is the hallmark of any quality program and should be a goal for companies interested in managing the risk of hazardous chemical operations. Continuous improvement for PSM systems is used to mean (1) the incremental increase in the performance of the PSM system with no significant increase in resources, or (2) the incremental increase in the cost-effectiveness of existing PSM activities resulting in equivalent or better PSM performance.

Mr. Marty Siecke of the Process Safety & Reliability Group presented a paper entitled, “Regulatory Compliance - A Burden or an Opportunity?” Siecke said that all businesses and organizations face the often, onerous tasks of complying with the many regulations intended to protect people from injury or protect the environment from damage. Should this compliance responsibility be addressed as a burden, or can it truly be an opportunity for improving the functioning and cost-effectiveness of our business? The simple answer: proactive management of regulatory compliance improves the bottom line! The same management systems, which improve compliance effectiveness, aid in profitability. All businesses stand to gain significant benefits if essential management system elements are in place.

Mr. David Clark of DuPont presented a paper entitled, “An Inherent Technology to Mitigate Vapor Cloud Explosions.” Clark said that vapor cloud explosions have caused damage, injury, and death. Typically, an explosion of this type is the result of the ignition of a flammable cloud formed by the uncontrolled release of a flammable vapor into a semi-confined and congested area. One of the principal hazards of a vapor cloud explosion is the overpressure created. The overpressure can cause structural damage and, both directly (via body translation, etc) and indirectly (via missiles, collapsed roofs, etc), injuries and fatalities. Only recently has emphasis been placed on the dramatic effect that the degree of congestion and confinement has on the magnitude and extent of the overpressure hazard. It is generally acknowledged that the greater the confinement and the greater the congestion, all other things being equal, the more damaging and potentially injurious the explosion. However, in the limit, a process area that is completely confined and completely congested, a block of solid concrete, for example, will obviously not pose a vapor cloud explosion hazard. Nor would an area that is completely filled with the “crimped metal” material that is typically used in the manufacture of flame arresters. Theoretically at least, such techniques are classified as “passive” process risk management strategies and are classified as “moderate” or “attenuation and limitation of effects” Inherently Safer Processing approaches to mitigate the vapor cloud explosion hazard. While the impracticality of using either of the above in a real process area is obvious, it is advantageous to acknowledge the fact that there is a degree of confinement and congestion above which the explosion hazard is actually lessened and to conceptualize practical techniques to take advantage of this fact.

Mr. Delmar Morrison of Packer Engineering presented a paper entitled, “Common Causes and
Corrections for Explosions and Fires in Improperly
Inerted Vessels.” Morrison said that causal factors and
corrective actions surrounding improperly inerted vessel
incidents are developed and compared. Several case studies of
flash fires or explosions involving these improperly inerted process
vessels are utilized for the
development. In industry, vessels
that contain or have contained
flammable vapors are commonly
inerted for many reasons but one
of the most common is explosion prevention. Common
inerting gases are carbon dioxide, nitrogen, steam and
air depending upon the specific application. Causes
ranged from procedures to design issues, but a general
set has been produced for application to the problem of
explosion prevention in process vessels. Each case study
is compared to safety standards to show how safe work
practices could have prevented the accidents, but rigid
adherence to safety standards may not be sufficient to
prevent an accident. The application of a safety standard
should be tempered by the situation-specific
circumstances. Some specific recommendations for
preventing explosions include methods for improved
mixing of the inert gas, the use of blinds, filling the
vessel with water, improved work procedures, and
improved monitoring procedures.

Mr. Gary Fitzgerald
of EQE International
presented a paper entitled, “A Comparison of Simple
Vapor Cloud Explosion Prediction Methodologies.” Fitzgerald said
that advances in research and
technology have sprouted several
approaches for the prediction of
vapor cloud explosion blast loads.
The three simple approaches most
used in industry are the TNO
Multi-Energy Method, Baker-Strehlow Method, and
the Congestion Assessment Method. The TNT
Equivalence Method, although still used to some extent,
is not being used as much as in the past since it has been
shown not to be representative of vapor cloud
explosions. Thus, it will not be reviewed in
this paper. The first method, the TNO Multi-Energy
Method, was first introduced in 1985 and updated in
1996. The Baker-Strehlow Method was introduced
in 1994, updated in 1997, and new blast curves were
presented in 1998. Lastly, the Congestion Assessment
Method was introduced in 1995 and updated in 1999.
However, no public comparison has been made of all
three approaches since their updates. Fitzgerald
provided a comparison of these three approaches with
available test data, case studies, and fictional processes.

Mr. Giby Joseph
of the US Chemical Safety
and Hazard Investigation Board presented a a paper
entitled, “Reactive Chemical
Incidents, What Does Existing
Data Tell Us?” Joseph said that
on April 18, 1998, a runaway
reaction initiated a sequence of
events that led to an explosion
and fire at the Morton Interna-
tional Plant in Patterson, New
Jersey. The U.S. Chemical Safety and Hazard Investiga-
tion Board’s (CSB) investigation of the Morton incident,
one in a series of recent reactive chemical incidents,
increased concerns regarding reactive chemical hazards.
To better understand the nature and causes of such
incidents, many stakeholders requested that the Board
pursue a more generic and systemic analysis of the
safety problems presented by reactive chemicals. As a
result, CSB decided to conduct a hazard investigation
that will review and evaluate historical trends involving
reactive chemical incidents and examine industry
preventative practices. To accomplish the first of these
two objectives, CSB is currently developing a database
of reactive chemical incidents. Joseph presented a
summary of lessons learned during development of the
database, as well as the findings from analysis of inci-
dent data.

Mr. Harold Johnstone
of the Dow Chemical
Company presented a paper entitled, “Evaluation of
Reaction Hazards for a Wiped-
Film Evaporator.” Johnstone
described a plant that desired to
increase its capacity by raising the
operating temperature of a wiped
film evaporator (WFE) unit. The
WFE separates a high-boiling
product (taken overhead) from a
heavy tar stream (taken out the bottom). Both the
product and the tars will begin to decompose at tem-
peratures near the operating temperature of the WFE.
The plant’s Management of Change procedure required
a consideration of reactivity hazards before making the
proposed change in operating temperature. This paper will describe the experimental work that was done with ARC and Setaram C-80 instruments on plant samples and the estimation of decomposition kinetic parameters that was done using Thermal Safety software from Cheminform, Ltd. Johnstone said that the results of the hazard evaluation allowed the plant personnel to make an informed decision about the proposed operating change.

Mr. Nir Keren of the Mary Kay O’Connor Process Safety Center presented a paper entitled, “Benchmarking Management of Change Practices in the Process Industry.” Keren said that Management of Change (MOC) is a relatively recent procedure that was mandated by the OSHA Process Safety Management (PSM) regulation. The performance-oriented nature of the PSM regulation allows for a wide variety of procedures or practices, which have been implemented in an attempt to comply with the MOC section of the PSM regulation. A benchmarking project was recently carried out by the Mary Kay O’Connor Process Safety Center to determine the baseline for various MOC activities. A questionnaire about MOC practice was sent to over 50 chemical and petroleum refining companies. The object of the questions was to identify the diversity of MOC application within the chemical processing industry. Keren presented the results of the benchmarking study.

Mr. Harvey Schulz of Wilfred-Baker Engineering presented a paper entitled, “Economical Mitigation of Explosion Hazards for Plant Siting.” Schulz said that the overpressure, impulse, and ultimate damage resulting from a vapor cloud explosion are primarily a function of flame speed, flammable mass, and the distance to the target. Flame speed is determined by the inherent burning velocity of the gas or vapor, equipment congestion, and confinement. Plant design criteria, including plant layout, process design, building design, unit operations, and maintenance are the ultimate governing criteria. Schulz provided an evaluation of risk mitigation decisions that are made during the plant design process as well as the mitigation of existing designs to reduce the probability and severity of damage from a vapor cloud explosion.

Dr. Hiroshi Koseki of the Japanese National Research Institute of Fire and Disaster presented a paper entitled, “Study on Risk Evaluation of Hydroxylamine/water Solution.” Koseki said that in order to find the cause of an explosive fire that occurred in Japan in June 2000, the decomposition hazards of hydroxylamine (HA) solution were studied experimentally. The thermal decomposition of HA solution was evaluated from calorimetric data obtained using differential thermal analysis (DTA). The magnitude of the intensity of decomposition was investigated on the basis of the results of a mini closed pressure vessel test (MCPVT), a pressure vessel test (PVT), a steel tube test, and a burning test of HA.

Dr. Homer Emery of the Bexar County LEPC of the San Antonio Water System presented a paper entitled, “Benchmarking Chlorine Safety Practices in the Water Industry.” Emery said that less than six percent of the total chlorine production in the U.S. is used for disinfecting drinking water and wastewater. However, this segment of the industry is responsible for the operation and maintenance of more than seventy-five percent of the sites exceeding the Risk Management Program (RMP) threshold level of 2,500 pounds for chlorine gas. This group also represents approximately twenty-one percent of the total RMP facilities that are currently listed by the Environmental Protection Agency (EPA). Emery reported on the development of benchmarks to characterize “best-in-class” operation and management practices for chlorine safety within the water and wastewater industry. A set of “straw-man” chlorine safety benchmarks was developed by the Emery from a review of more than one hundred water industry RMP narratives and a survey of thirty water and wastewater utilities. Using a Delphi expert panel review procedure the set of “straw-man” benchmarks is now being modified and prioritized to identify operational and management practices that should be emphasized within the water industry to reduce community risks associated with chlorine use at more than 5,000 sites in the U.S.
Mr. Jack Philley of DNV presented a paper entitled, “Potential Impacts to Process Safety Management From Mergers, Acquisitions, Downsizing, and Re-engineering.” Philley said that significant potential impacts to process safety management performance can be generated by corporate organizational mergers, acquisitions, downsizing, and re-engineering. Philley explored a selection of consequences (favorable as well as unfavorable) and presented possible options for addressing this new and broad-based challenge. Loss of in-house PSM expertise and surge capacity is a prime example. Demographics indicate a bell curve of experienced personnel in the process industries are approaching normal and early-retirement age. Rapid expansion of the process industries in the 1960’s and 1970’s brought in a large group of workers. Retraction of the process industries in the late 1980’s significantly reduced the number of people entering this segment of the workforce. These two events have combined to generate a bell-curve distribution of experienced personnel, who are now leaving the industry as a result of downsizing, mergers, and other re-organizations. Retention of this experience is a serious challenge to successful management of process safety. There is an increasing likelihood lessons learned may be permanently lost.

Mr. James Hemsath of BP Exploration Alaska presented a paper entitled, “System Simulation of a Management of Change process in a North Slope Oil Exploration Facility.” Hemsath said that our ability to manage the integrity of our facilities is directly related to our ability to manage change. Management of Change as a component of PSM has been part of the processing industry since 1994, yet in that time very little if any improvement has been observed in the overall safety performance at facilities. Hemsath asserted that the reason for this lack of performance is that the MOC process is not managed but rather it is just used. The ability of an organization to leverage change to their advantage and to minimize the risks involved with implementing change, at any level, is dependant on the organizational structure and tools put into place – it is dependant on the management system and the effectiveness of that system. A management system can be defined as an approach whereby a series of components or steps are put together to solve a problem or make an improvement in internal efficiency and external effectiveness. Hemsath reviewed the Management of Change process for a major North Slope Oil Production facility against the five components of a management system - Scope, Process, Organization, Performance Measurement, and Feedback.

Mr. John Vorderbrueggen of General Physics Corporation presented a paper entitled, “SPR Operations & Maintenance Benchmark Study.” Vorderbrueggen presented his findings on the “Benchmark Study of Operations and Maintenance at the Strategic Petroleum Reserve.” By comparing the internal review, conducted at the SPR sites, with identified best practices and documented best practices at the five private industry benchmark companies, the SPR was able to identify operational and maintenance improvement alternatives that can be used to improve SPR operational and financial performance. Haverly’s paper and presentation identify and discuss the lessons learned from the study, as well as the application of benchmark processes to operations and maintenance issues in private industry.

Mr. Jeff Marx of Quest Consultants presented a paper entitled, “What is a QRA and What Can It Tell You?” Marx said that over the past ten years, there has been a growing focus on risk analysis and risk assessment in the process safety community. Regulations like the EPA’s Risk Management Program have brought the word “risk” to the forefront of our discussions. One problem that is apparent during such discussions is the lack of a common frame of reference for terms such as risk analysis, risk assessment, and quantitative risk analysis (QRA). Even if all parties in a discussion agree that risk is the combination of the consequences and probability of occurrence of an unwanted event, they might still disagree on what
constitutes a QRA. Unfortunately, risk assessments and qualitative or semi-quantitative risk analyses are often referred to as QRAs, as are studies that include the generation of a risk matrix. A true quantitative risk analysis for a process plant is a complex and extensive study that involves consequence modeling, probability data, vulnerability models/data, local weather and terrain conditions, and (sometimes) local population data. This detailed type of study has many useful applications, but only if done correctly. Without the required tools or data, attempts to perform a QRA generally produce results that have little value. Marx proposed to clarify what a QRA is and what it is not, and to show the types of information that can be generated when correctly performing a QRA for a petroleum, petrochemical, or chemical processing facility.

Dr. Tom Spicer of the Chemical Hazards Research Center, University of Arkansas presented a paper entitled, “Modeling Aerosol Rainout.” Spicer said that the AIChE Center for Chemical Process Safety has coordinated research efforts aimed at characterizing and predicting the behavior of aerosols during accidental releases. Field tests designed to be used for validation of a predictive model (RELEASE) showed that aerosol rainout was a significant factor under the test conditions. In addition to summarizing the RELEASE model and the data from the field test, Woodward and Johnson (1999) corrected the measured aerosol rainout to account for the experimental conditions; their corrections rely on an initial estimate of the jet velocity that is not limited by choked flow conditions (sonic velocity). Spicer discussed the jet expansion zone and impact of other models of the jet expansion zone that influence the predicted aerosol rainout of the RELEASE model.

Mr. James Manzella of Lonza presented a paper entitled, “Measuring Safety Performance to Achieve Long Term Improvement.” Manzella summarized the types of “event” reporting (near misses, first aid cases, OSHA reportable injuries/illnesses, etc.) and stresses the importance of measuring worker conformance to established systems, as an effective and necessary tool in order to control injuries, process upsets, and catastrophic events. Such measurements allow risks to be identified before injuries and process events occur. A system that identifies and controls non-compliance to established standards is much more effective than one which identifies and corrects errors after an injury or process event occurs. When errors are common, risk is increased. The greater the likelihood of error, the greater the chance of injury and process upsets. If a safety program relies on “after the fact” data to establish safety performance objectives, these goals will be difficult to reach and maintain. If a firm establishes proper methods to perform activities and employees perform as expected, injury performances will continuously improve as risk is reduced. The key is to establish effective safety systems and measure conformance to those systems to ensure activities are performed as expected.

Mr. Duncan Smith of Risk, Reliability and Safety Engineering presented a paper entitled, “Offshore Risk Assessment - Simple or Complex?” Smith said that risk assessment for offshore facilities began shortly after the Piper Alpha incident in 1988. At this time, the UK Health and Safety Executive issued rules for Safety Cases for offshore installations. Safety Cases are now required in many parts of the world. Operations in the Gulf of Mexico (GOM) are becoming larger, more complex, and in deeper water. The potential exists for future regulations that require some type of Safety Case or risk assessment in the GOM. Risk assessments in the North Sea have historically been very complex and costly, with suspect benefit other than meeting a regulatory requirement. Companies are now recognizing that performing a risk assessment on new and existing offshore facilities is a good business practice. A risk assessment performed during the design phase can reduce both capital and expense costs, and result in a safer facility.

Dr. John Woodward of Wilfred-Baker Engineering presented a paper entitled, “SS3G - An Integrated Risk Analysis Program Using Engineering Principles for Building Damage.” Woodward said that with the with the support of an industrial consortium, Wilfred-Baker had developed an integrated modeling
system named SS3G (Safe-Site 3rd Generation). This system is the first such risk analysis program to provide a component-by-component analysis of building damage to explosions. It also employs new and extensively verified correlation for occupant injuries as a function of building damage level. The SS3G system provides a modern interface based on a plot plan of a plant. Using a mouse, a user traces out diked areas (potential pool fire sites), congested areas (potential explosion sites), and target buildings. With a mouse click he defines the location of release points. Pop-up screens complete the definition of all sources, buildings, etc. SS3G has modules to model discharge rates, aerosol formation and rainout, pool spread and evaporation, and dispersion, both outdoors and indoors.

Ms. Kelli McEldowney of Battelle presented a paper entitled, “Evaluating Safety Instrumented System Needs Using Process Hazard Analysis Data.” McEldowney said that determining Safety Instrumented Systems (SIS) needs is the first step of a long process of complying and maintaining compliance with national and international standards. How a company goes about determining SIS needs can have a significant impact, not only on process safety, but also on process economics. Much of the process analysis used to evaluate the need for SIS, based on Safety Integrity Levels (SIL), is already included in process hazards analyses. Using existing analyses will allow you to minimize “re-analysis” and help focus SIS and recommended actions on plant economics.

Mr. Kiran Krishna of the Mary Kay O’Connor Process Safety Center presented a paper entitled, “Understanding the Formation of Heat Transfer Fluid Aerosols in Air.” Krishna said that mist or aerosol explosions present a serious hazard to process industries. Heat transfer fluids are widely used in the chemical process industry, are flammable above their flash points, and can cause explosions. Though the possibility of aerosol explosions has been widely documented, knowledge about the explosive potential of such aerosols is limited. Studying the formation of such aerosols by emulating leaks in process equipment will help define a source term for aerosol dispersions and aid in characterizing their explosion hazards. Current research by the Mary Kay O’Connor Process Safety Center involves the non-intrusive measurement of such aerosol sprays using a Malvern Instrument Diffraction Particle Analyzer. Predictive models relating the aerosol formation distances, aerosol droplet sizes, and volume concentrations to bulk liquid pressures, temperatures, fluid properties, leak sizes, and ambient conditions are developed. These models will be used to predict the conditions under which leaks will result in the formation of aerosols and ultimately help in estimating the explosion hazards of heat transfer fluid aerosols. Important information can be gleaned about the effects of various fluid properties on aerosol formation behavior. The goal is to provide information that will help improve process safety in industry.

Mr. Kirk Clark of Horizon Consultants presented a paper entitled, “Tolerable and Acceptable Risk: Establishing Quantitative Targets for the HPC Industry.” Clark presented the background and basis for establishing acceptable and tolerable levels of fatalistic risk specific to the Hydrocarbon/Petrochemical/Chemical (HPC) industry, and it suggests both a target level of risk and a boundary region. It also implies that tolerable fatalistic risk levels should be an industry wide standard and not governed or decided by individual organizations. Further, the criticality of having an acceptable risk reduction target suggests that it is imperative for regulatory bodies and/or their standard setting organizations to adopt and publish these criteria.

Dr. Lawrence Beckman of HIMA-Americas presented a paper entitled, “Expanding the Applicability of ISA TR84.02 in the Field.” Beckman said that the ANSI/ISA S84.01 standard was released in 1996. The companion Technical Report TR84.02 is in the process of being completed. The latter document is intended to provide the methodology to implement the safety performance requirements of the standard for the safety
In this document three (3) techniques are presented; these being Simplified Equations, Fault Tree Analysis, and Markov Modeling. Of the three, only the Simplified Equations approach would reasonably be utilized in the field by plant personnel. The Simplified Equations provided in Part 2 of ISA TR84.02 comprehend common cause failures, systematic failures, and second failure prior to repair scenarios. They do not however comprehend the use of redundant field devices that are dissimilar, and as such have different failure rates. This situation is quite common in practice, and simple to manage using enhanced equations for the computation of PFDavg. A set of these equations for typical redundant architectures in the field and several examples of their applications in safety loop analysis are derived and presented in this paper.

Ms. Leslie Jensen of ProSys presented a paper entitled, “The Pitfalls of Alarm Rationalization and Benchmark Analysis.” Jensen said that the noble goal of reducing the overload of process control system alarms has lead to many approaches, some more worthy of the task than others. The pressure to do ‘something’ about alarms is becoming so great that the theme has reached the level of corporate edict. Yet additional pressures of time, budget and resource constraints can lead to poor decisions with unexpected results. The search for a quick, prepackaged solution can even lead to a dangerous false sense of security. The dangers can be further masked by faulty analysis of the results. The basis of the alarm management approach taken and the predefined limitations to the approach are critical in determining success. Jensen highlighted the pitfalls and illusionary benefits of some alarm management approaches and offered suggestions on how to formulate an approach to analysis and solution development that is not limited by static preconceptions and artificial restrictions.

Ms. Lizbeth Cisneros of the Mary Kay O’Connor Process Safety Center presented a paper entitled, “Effect of Air in the Thermal Decomposition of 50 wt.% Hydroxylamine/water (HA) in an oxygen-free environment using an APTAC calorimeter. Overall kinetics, onset temperatures, heats of reaction, and energy release rates vs. temperature are presented. These results are compared with the corresponding data for HA decomposition reaction in air. This information is especially valuable for the design of HA storage facilities. Cisneros also presented the gas-phase decomposition products measured by spectrophotometry for the HA decomposition reaction in air.

Mr. Michael Dore of Lowenstein Sandler presented a paper entitled, “The Role Of Community Advisory Panels In The Aftermath Of Critical Incidents In The Chemical Processing Industry.” Dore said that since the advent of “Responsible Care” initiatives, Community Advisory Panels (“CAP”) have played an important role in ensuring community involvement in the safe operation of chemical facilities. Little consideration has been given, however, to how CAP’s should function in circumstances where process safety efforts have failed and explosions, fires, off-site releases, or other critical incidents occur. In such circumstances, chemical processing facilities face a host of immediate and longer term concerns. These include rescue and response efforts; environmental and other notifications; assistance to governmental response agencies; damage assessments; insurance notifications; computer and other records recovery; public communications activities; site security and remediation, business continuation and recovery; and incident investigation. The role which CAP’s can and should play in these activities will be effected by the makeup of the CAP, the relationship of prior CAP activity to the critical incident, the nature and severity of the incident, the governmental response to the incident, and a number of other factors.

Dr. Marc Levin of Equilon Tech presented a paper entitled, “The Reactivity of Butadiene with Acetylenic Hydrocarbons via Adiabatic Calorimetry.” Building upon recent studies of the behavior of conju-
gated diolefins and alkynes individually, a study involving adiabatic calorimetry has been undertaken to characterize the reactivity of combinations of 1,3-butadiene with selected alkynes. Mixtures of 1,3-butadiene with methyl vinyl acetylene (a conjugated alkene-ynene) along with mixtures of 1,3-butadiene with methyl acetylene have been tested in the Automatic Pressure Tracking Adiabatic Calorimeter. Levin compared the results from these tests with the reactivity of the individual species. In the case of butadiene plus methyl vinyl acetylene, mixtures exhibit exotherm onset temperatures intermediate between those of the pure components. Compositional analysis of reaction product has been conducted to elucidate the role of the Diels-Alder condensation pathway in these tests.

Mr. Matt Railean of Berwanger presented a paper entitled, “Quantitative Risk Analysis (QRA) for Relief Headers and Flare Systems.” Railean said that as process industry facilities increase production capacity and add processing units, existing relief headers and flare systems are frequently found to no longer meet the same conservative design criteria used for the original design of the facility. Quantitative Risk Analysis (QRA) may be used to develop a more detailed understanding of the safety issues associated with the design of such systems. Railean presented examples in which the application of QRA had resulted in large cost savings by revealing that proposed multi-million dollar relief header and flare system modifications would have resulted in insignificant reductions in a facility’s risk to personnel safety. QRA also allows the inclusion of the impact of safeguards - such as shutdowns, conventional instrumentation, and operator intervention - on the likely consequences of an initiating event. Although the assumption that no safeguards are present is reasonable when evaluating the pressure relief for an individual piece of equipment, it becomes unnecessarily conservative as the number of safeguards involved in the event increases. The inclusion of the initiating event frequency and safeguard reliability yields a frequency versus outcome relationship for variables of interest to flare system design - such as system hydraulics, flare tip design capacity, flare radiation levels, and knockout drum performance. A review of this relationship versus corporate risk tolerance criteria can be used as an important tool when deciding whether costly upgrades should be implemented. The result of the QRA process is a more realistic and comprehensive assessment of the risks associated with relief headers and flare systems.

Ms. Michela Gentile of the Mary Kay O’Connor Process Safety Center presented a paper entitled, “Development of an Inherent Safety Index Using Fuzzy Logic.” Gentile said that Inherently Safer Design is a concept known since 1870. However, there is a general resistance to adopt and systematically apply its principles because they are subjective. For instance: “Reduce the inventory of a hazardous chemical substance.” But, how much should the inventory be reduced? “Simplify your process.” How to know if the process is simple enough? Things cannot be classified strictly as “safe” or “unsafe”. Something can be perceived as “not very safe” or “highly unsafe.” One of the greatest challenges is to answer quantitatively the question “How safe is a chemical plant?” In order to quantify the safety level we need to capture all the possible options between the extremes of safe/unsafe. If we think in terms of traditional mathematics (Boolean logic), an element can only be inside or outside of a set. In other words, the element can only be safe or unsafe. What happens with the “not very safe” element? Gentile proposed an approach based on fuzzy set theory. She discussed how the required membership functions can be developed and demonstrated the application of the methodology by calculating the inherent safety index for a simple processing unit.

Mr. Rick Knack of Knack Associates presented a paper entitled, “Process Safety Documentation: The Good, the Bad, and the Ugly.” Knack said that we all pay lip service to the need for good process safety documentation. PHAs are required to be kept for the life of the process and must be readable by the next team in five years. Process safety information provides the
anchor on which our processes are based. Management of change documentation is essential to understanding the technical bases of changes and ensuring that they are implemented correctly. There are multiple requirements for good mechanical integrity documentation. While we all recognize the need for good documentation, in many cases the documentation itself receives less attention than necessary. There are numerous reasons for this in budgetary, personnel, and time constraints. None-the-less, good documentation is a must. Knack presented examples of good and bad documentation. They describe why from safety and liability standpoints as well as legal requirements, it is essential that all PSM documentation be maintained with high standards.

Dr. B.P. Das of Loughborough University presented a paper entitled, “Reducing Accident Causation in Complex Plants by Identifying Mutual Misconceptions Between Designers and Operators.” Das said that catastrophic accidents in complex plants arise from an unforeseen combination of a number of factors. Although much effort has been invested in both improving the reliability of components and the design of user interfaces, human error and complex plant failures still occur. One contributing factor to plant accidents is the nature of understanding that design engineers and operators have of each other, or rather the mutual misconceptions that arise between them. For example, operators may adopt practices that do not reflect the demands and limitations inherent within the design of a plant. Similarly, the design engineer may prescribe practices that cannot be successfully completed due to limitations inherent within operators. Das described the development of a database that attempts to capture these mutual misconceptions. The database has been produced from causal analyses of case studies of previous accidents involving complex plants. In addition, the database forms the basis of the development of an agenda-generating mechanism for use by designers and other decision makers. The tool provides cues to key decision points and managerial activities that influence the design and operation of a plant. It lets the decision makers choose the level of abstraction at which they are cued by the agendas of misconception type. For example, in writing shut down instructions, it is important that the authors can see all the main types of operator misconception that are associated with shutdown activity, and that they can navigate to more detailed sub-types, or even specific accident accounts. The tool is designed to help decision makers avoid the types of mutual misconceptions that have been implicated in previous plant accidents, and hopefully increase their understanding of the demands they place upon operators.

Ms. Delilah Barton of Marasco Newton Group presented a paper entitled, “Handling a Crisis Situation Through Media Training.” Barton said that when an abnormal situation occurs at a facility, management must be prepared, not only to handle the situation itself, but also to effectively communicate with stakeholders. The media is a very important vehicle for this communication. However, media coverage can either be a fiasco for public relations or it can be an effective and successful tool to maintain stakeholder support. What happens to a company’s image in the aftermath of a crisis is a direct result of how well they are prepared to address the situation and communicate to the media, and how closely the company follows its mission and values. When an unexpected situation or issue threatens the ability of a company to complete its mission, the company’s crisis management team must meet to determine the severity of the crisis, how to resolve the situation, and how to communicate the status and/or solution to the crisis to its stakeholders through the media. A major part of a company’s ability to navigate through the critical situation is its ability to successfully communicate its message to its stakeholders, frequently through tough questions from the media.

Mr. Tim Overton of the Dow Chemical Company presented a paper entitled, “Integration of a Reactive Chemicals Program into the Process Hazard Analysis Process at The Dow Chemical Company.” Dow’s Reactive Chemicals Program has been in place since 1967 and has been utilized glo-
bally by Dow to reduce the hazards associated with reactive chemical scenarios. With the evolution to a broader Process Hazard review, Dow has integrated the Reactive Chemicals program into the framework of the PHA reviews. The current Reactive Chemicals/Process Hazard Analysis (RC/PHA) program involves an interaction with several diverse technical experts to study the chemistry and processing activities, looking for any potential risk reduction opportunities. By completing this review and the associated follow up, the facility or Project helps to fulfill compliance with Dow’s Process Hazard Review requirements, as well as those of several regulatory directives such as OSHA PSM and Seveso II Directive for Process Hazard Analysis.

Mr. Roy Sanders of PPG Industries presented a paper entitled, “Picture This! Incidents that Could Happen in Your Plant.” Sanders provided a summary of several incidents as an opportunity to learn from the misfortunes resulting from flaws in judgment on minor decisions. These chemical plant case histories involve relatively minor errors in design, operation or maintenance. These incidents occurred within ordinary equipment found in most plants and refineries. Each minor error resulted in an unforgettable incident for the involved designers, operators and maintenance crews, as well as their supervisors. The fundamentals covered can be shared in a technical review meeting or within the control rooms. As our knowledgeable supervisors and veteran operators hired in the 1960’s and 1970’s (the boom years for hiring) continue to retire, we must share our past experiences with our leaner crews to avoid repeated incidents.

Mr. Sanjeev Saraf of the Mary Kay O’Connor Process Safety Center presented a paper entitled, “Of Computers, Chemistry, Chemical Engineering, and Reactivity.” Saraf said that with the availability of powerful computers and continued reduction in computing cost, it is routinely possible to calculate the physico-chemical properties of chemicals. He provided an overview of state-of-the-art calculation models available for data prediction with implications for chemical process safety and especially chemical reactivity. Hydroxylamine is a highly reactive and poorly characterized compound with important industrial applications. Practical methods for estimation of thermodynamic properties, phase behavior, and solvation energetics are exemplified through calculations on hydroxylamine. Finally, a reaction pathway for hydroxylamine decomposition is proposed, together with a transition state. Saraf said that the proposed techniques can be extended to other compounds.

Mr. Kirk Fontenot of Honeywell presented a paper entitled, “Economic Justification for Process Safety Systems.” Fontenot said that improving the overall safety within the process industries requires that process safety programs and projects get funded by plant management. In this day of increasing competitiveness in the global marketplace, the competition for capital expense dollars internally within an operating company is fierce - and every program and project must deliver solid economic payback to justify funding. Unfortunately in many cases, it is not enough for Safety Professionals to present risk mitigation and compliance to regulations as justification for process safety projects when the economic payback is often more obvious for other types of projects vying for the same investment dollars. Risk mitigation can be seen as unnecessary for managers who have not experienced an incident, or who will be moving around the corporate ladder within the next 3-5 years - their need is to make the bottom line look good in the near future. Also, standards and regulations are subject to interpretation and the implications of non-compliance misunderstood. Understanding these factors is critical because for every proposed project, management will always base their decision on a cost/risk analysis – usually looking for a 1-2 year payback at the most. If left to their own, management will make this analysis on proposed safety projects. It is better for Safety Professionals to present a solid economic justification and make this analysis than to let management do this themselves.
Mr. Stephen Anderson of APTECH Engineering presented a paper entitled, “Risk Based Inspection Case Studies: Does RBI improve plant safety?” Anderson said that in order for a facility to extend the operating lifetime of pressure vessels and piping, safely and cost effectively, it is necessary to implement the latest inspection and maintenance strategies. Risk Based Inspection (RBI) has its roots in Process Safety Management and Mechanical Integrity programs and is gradually becoming accepted as good engineering practice for the implementation of inspection and maintenance programs. Anderson described the methodology, analysis and results of Risk Based Inspection studies conducted on several refineries and petrochemical facilities. These studies have resulted in numerous benefits for the plants, which include safety and compliance issues, cost savings, focussed inspection plans and assisting management in making informed, defensible operational decisions.

Mr. Thomas Rodante of ECRC presented a paper entitled, “Analysis of an LPG Explosion and Fire.” In September 1997 an LPG release occurred at the Hindustan Petroleum Corporation, Ltd refinery in Vishakhapatnam, India. The resultant explosion and fire destroyed most of the facility’s administrative buildings, numerous LPG storage vessels, processing units, and an adjacent petroleum liquid storage terminal. Loss of life was declared at 56, but could have been as high as 3 times the official estimate. Property damage was estimated at US $15 Million dollars. During receipt of LPG cargo from a pressurized ship, a leak occurred. The subsequent vapor cloud spread throughout the refinery tank farm, administrative complex, utilities area, and at least one process unit before eventually finding an ignition source. The investigation team developed numerous release theories. However, none of these theories could be substantiated by first-hand witness testimony since all personnel directly involved in the tank filling operation were killed. Vapor cloud dispersion computer modeling was used to evaluate the credibility of various release scenarios. Rodante discussed the events leading up to the explosion, the damages sustained, and the comparison of quantitative dispersion modeling results to the physical damage and witness testimony obtained during the investigation.

Ms. Yanjun Wang of the Mary Kay O’Connor Process Safety Center presented a paper entitled, “Computer-aided Fault Tree Synthesis for Quantitative Risk Assessments.” Fault tree analysis (FTA) has been used in the chemical process industry (CPI) for systematic safety and reliability analysis during the past decades. Once constructed, the fault tree can be of considerable value in determining the paths for propagation of basic events through the system to cause the top event. Algorithms exist that determine which basic events, or combinations of primal events (minimum cut set analysis), will cause the top event for a given fault tree. While much of the statistical and cut set analysis has been automated, construction of a fault tree is usually done by hand. Manual construction of the tree can be extremely time consuming and vulnerable to human errors. Satisfactory algorithms for fault tree synthesis are not available, especially when control loops are encountered. Ideally the system failure models should be independent of the synthesis method, but in practice they are strongly interdependent.
2002 CALENDAR

Tuesday, March 19, 2002
Executive Forum Meeting
Great Southwest Equestrian Center
Katy, TX

Wednesday, March 20, 2002
Technical Advisory Committee Meeting
Great Southwest Equestrian Center
Katy, TX

October 29-30, 2002
2002 Symposium