

AICHE Alliance

# SACHE News

Safety and Chemical Engineering Education

## Safety and Chemical Engineering Education - Summer 2011

### How to Meet New ABET Requirements on Hazard Management

A workshop for academics offered by SACHE /  
CCPS at the  
AIChE Minneapolis Annual Meeting

Sunday, October 16, 2011  
8:00 am to 12 noon

Starting with program visits in 2012, ABET will be requiring the accredited Chemical Engineering curricula to provide graduates with knowledge to address the hazards associated with the types of processes covered by curricular objectives. To help faculty and departments implement these new requirements, this workshop will provide an interactive environment with leading process safety practitioners and academic instructors to improve their understanding of how process safety is implemented in an industrial environment to address potentially catastrophic hazards.

The workshop will use elements selected from the interactive modules developed by AIChE's Center for Chemical Process Safety (CCPS). We will cover process hazard analysis, process safety management in process design and plant operations, risk analysis and risk management. Ways to present this material in an instructionally rigorous manner will be discussed.

For more information visit

<http://www.aiche.org/Conferences/AnnualMeeting/2011/S1.aspx>.

Editor's Note: The criteria for accrediting engineering programs can be accessed under the Resources for programs link at <http://www.abet.org/index.shtml>.



Houston, TX  
April 1-4, 2012

**Call for Papers is open**

<http://www.aiche.org/Conferences/specialty/GCPS.aspx>

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SACHe, or Safety and Chemical Engineering Education, is a project under the auspices of AIChE's Center for Chemical Process Safety (CCPS). SACHe's charter is to enhance the presentation of process safety in undergraduate education.

*SACHe News* is published twice annually by the Undergraduate Education Committee of the AIChE Center for Chemical Process Safety. All original material is copyrighted by the AIChE Center for Chemical Process Safety.

The opinions expressed in the articles contained in *SACHe News* are not necessarily the opinions of the Center for Chemical Process Safety or the American Institute of Chemical Engineers.

Articles related to any aspect of safety in the academic community are solicited from both the academic and industrial communities for publication in *SACHe News*. Material should be sent directly to the editor for consideration.

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## **Integrating Safety Into the Chemical Engineering Curriculum – Where, What, and How**

**Chair:**

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Mark R. Anklam

Email: [anklam@rose-hulman.edu](mailto:anklam@rose-hulman.edu)**Description:**

The AIChE Education and Accreditation Committee proposed new instructional requirements for process safety in the undergraduate chemical engineering curriculum which are expected to become effective starting with accreditation actions during the 2012-2013 academic year. Departments must demonstrate that their graduates have sufficient knowledge to address the hazards associated with chemical and/or biological processes. The purpose of this session is to assist chemical engineering departments in meeting these new requirements through presentations that focus on helping experts and non-experts find new or better ways to integrate safety into their courses and curricula. Abstracts are requested in topic areas such as: how and where to integrate process safety into core courses, what to incorporate in a dedicated course in process safety and hazard recognition, how to include the Safety and Chemical Engineering Education (SACHE) safety certificate program, how to use and where to find educational materials and resources (such as SACHE products) for process safety instruction, how to demonstrate that students have sufficient knowledge and can address hazards, and what to include in the curriculum to prepare students for the broad and diverse industrial needs in process safety. Contributions are accepted from U.S and non-U.S. sources, and academic, industrial and government communities.

**Sponsor:**

Education

**Co-Sponsor(s):**

Safety &amp; Health Division (11b)

**Part 1:****Tuesday, October 18, 2011: 8:30 AM – 11:00 am**

Marquette I (Hilton Minneapolis)

**8:30 AM**

(232a) Process Hazards Emphasis In the New ABET Chemical Engineering Program Criteria

Jeffrey J. Siirola

**8:50 AM**

(232b) Promoting Acceptance of Process Safety Curriculum Requirements

Scott Berger

**9:10 AM**

(232c) Resources, Recommendations and Overcoming Challenges for Integrating Safety Into the Chemical Engineering Curriculum

Amy Theis

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**9:35 AM**

(232d) Educational Resources On Process Safety at the SaChE Website  
Thomas O. Spicer

**10:00 AM**

(232e) Continuing Our Journey to Bridge the Process Safety Gaps Between Academia and Industry  
Bruce K. Vaughen, Thomas O. Spicer, D. "Trey" Morrison, James A. Klein and David A. Rockstraw

**10:25 AM**

(232f) Exposing the Blurry Lines Between Personal Safety and Process Safety Education: Contrasting NIOSH Prevention Through Design (PtD) with CCPS SaChE  
Delmar R. Morrison, Ryan J. Hart and Pamela Heckel

**10:50 AM**

(232g) The 3rd Edition of Chemical Process Safety, Fundamentals with Applications  
Daniel Crowl and Joseph F. Louvar

**Part 2:**

**Tuesday, October 18, 2011: 3:15 PM – 6:00 pm**  
Marquette I (Hilton Minneapolis)

**3:15 PM**

(382a) Affecting Change: Creating a Culture of Safety within a Chemical Engineering Education Program  
John F. Sandell, David W. Caspary and Anton J. Pintar

**3:35 PM**

(382b) Safety Education throughout the Undergraduate and Graduate Experience At Michigan Tech  
Faith A. Morrison and Adrienne Minerick

**3:55 PM**

(382c) A Treasure Hunt towards Process Safety in the Unit Operations Laboratory  
Ronald J. Willey, Kathleen Ziemer and Tracy Carter

**4:15 PM**

(382d) The Ohio State University Process Safety Education  
Robert W. Johnson

**4:40 PM**

(382e) Introducing Engineering Students to Assessment of Process Hazards  
James A. Klein, Seshu Dharmavaram and Richard A. Davis

**5:00 PM**

(382f) Implementing Conservation of Life Across the Curriculum  
Richard A. Davis and James A. Klein

**5:20 PM**

(382g) Teaching Safety – a British and European Experience  
Martin J. Pitt

## Additional SACHE Products for 2011 and 2012

The SACHE educational resources are available on the SACHE website (<http://www.sache.org>). The SACHE representatives have their institution's userid and password required to download these resources.

### Jeopardy Contests for Process Safety

Jon Vernardi  
Lubrizol Corporation

This SACHE product contains some important elementary concepts in chemical process safety. The understanding of these concepts is assessed and reinforced with two class Jeopardy Games. For the game, it is recommended to divide the class into teams of four or five students. Topics include process descriptions, process safety management, process control, flammability, corrosion, relief device basics, and Design Institute for Emergency Relief Systems (DIERS).

This SACHE product includes:

- Background resources for some questions (student resources to study)
- Two PowerPoint case history presentations (student resources to study)
- Jeopardy Game instructions for the game facilitator, and
- Two Jeopardy Games

**Student access:** The Background resources and the two PowerPoint presentations are available to students through the site.

### A Process Safety Management (PSM)

#### Overview

Bruce K. Vaughan  
Cabot Corporation

The objective of this product is to provide an overview of the basic elements of a Process Safety Management (PSM) system. An effective PSM system ensures the safety, health, and welfare of people, the community and the environment by understanding and controlling process

hazards. The product defines PSM, Operational Discipline (OD) and Risk, and it describes an approach to process safety risk reduction as well as discussing basic concepts describing the PSM elements that comprise an effective system.

This product includes:

- A two-part PowerPoint presentation
- Lecture notes
- Handouts

and can be used by faculty, industrial trainers, and students. Details or specific examples can be added to the PSM elements in the presentation.

**Student access:** All files are available to students logged into the site.

### Fundamentals of Chemical Transportation with Case Histories

Ronald J. Wiley  
Northeastern University

Chemical engineering students typically receive little formal training in the transportation of materials beyond the flow of material within a pipe. Yet, raw materials must arrive by some means, and products need to be shipped. In hazard analysis, it is often vitally important that the chemical engineer consider the details of material transfer beyond the pipe. The engineer should be aware of the many regulations that cover the transfer of commercial materials. They should have some sense of the potential hazards of the various means of transportation based on past incidents. They should understand the signage on various transport vessels should an accident occur within the plant or neighborhood and they are called upon to offer expertise in clean up. This overview of transportation of chemical materials addresses these topics and includes several case histories. Review of the total package requires two to three hours. For a classroom presentation, portions can be shown within a 45 minute lecture with several memorable photos, particularly in the section "Why I lost my job today."

**Student access:** All files are available to students logged into the site.

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## Conservation of Life: Application of Process Safety Management

J. Klein  
DuPont

This SACHE product introduces “conservation of life” (COL) as a fundamental principle of chemical engineering design and practice, equivalent in importance to conservation of energy and mass. This presentation provides a good introduction to application of process safety and provides an overall structure for consideration of process safety by students.

COL principles that are discussed include:

- Assess material/process hazards
- Evaluate hazardous events
- Manage process risks
- Consider real-world operations
- Ensure product sustainability

Most of the presentation is spent on the first three principles, which are most important to chemical

engineering design and education, but all principles are introduced. Important factors for assessment of toxicity, flammability, reactivity, and dust hazards are provided. Use of PHAs, layers of protection, inherently safer methodologies, and human factors for managing process risk are highlighted. The “Swiss Cheese Model” is also introduced to consider how layers of protection can fail, potentially leading to catastrophic incidents such as the Deepwater Horizon oil spill in 2010.

This product can be used in the university (introductory engineering, design, or kinetics courses) or for the introduction of process safety for new industrial employees. COL can be used by universities as a concept and unifying theme for increasing awareness, application, and integration of process and product safety throughout the chemical engineering curriculum and for meeting the revised ABET accreditation criteria.

**Student access:** All files are available to students logged into the site.

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## SACHE Student Safety Certificate Program

A Certificate of Safety Achievement is presented by SACHE and AIChE to students who demonstrate proficiency in process safety training modules developed for SACHE. The program allows students to receive recognition for their efforts provided they are members of AIChE. Student application for AIChE membership is available at <http://www.aiche.org/students>.

You must be logged in as a student to view Student Certificate Program files. [Log in here](#) to view these files. After students have completed a module, they must successfully complete an online questionnaire which is available at [http://www.aiche.org/SACHE\\_Questions.aspx](http://www.aiche.org/SACHE_Questions.aspx) to receive recognition. Lists of students who successfully complete a module will be sent to their SACHE contact school or department in addition to companies who are supporting the program; see the list of students who have completed the certificate in [2008 \(PDF\)](#), [2009 \(PDF\)](#), [2010 \(PDF\)](#), or [2011 \(PDF\)](#) (or [2011 \(Excel format\)](#)).

For further information, please contact June Lee ([junel@aiiche.org](mailto:junel@aiiche.org)).

The following modules are presently included in the program:

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## **Dust Explosion Control**

Joe Louvar, Wayne State University, 2010

Introduces background for understanding and preventing dust explosions.

### **Introduction**

Dust explosions have received a lot of attention in recent years from industry and the U.S. Chemical Safety Board (CSB). CSB has made recommendations that should help prevent dust explosions, and this certificate is based on these recommendations.

To obtain this certificate, students should study all of the below resources and then pass the online exam to successfully complete this Safety Certificate.

## **Inherently Safer Design**

Dennis Hendershot, CCPS Staff Consultant, 2009

Provides information for understanding inherently safer design of chemical processes and plants.

### **Introduction**

Inherently safer design has received a lot of attention in recent years from industry, environmental groups, and has even been discussed in the general public and mass media. As of the summer of 2009, the state of New Jersey requires a consideration of inherently safer design options for facilities covered by its Toxic Catastrophe Prevention Program (TCPP), and Contra Costa County, California (east San Francisco Bay area) requires a similar evaluation for facilities covered by its industrial safety ordinance. Bills have been introduced in the United States Congress requiring consideration of inherently safer design, both for safety and also for potential benefit in making chemical facilities less attractive targets for terrorist activity. As of the summer of 2009, these proposals had not passed in Congress, but legislation is again under consideration.

To obtain this certificate, students should study all of the below resources and then pass the online exam to successfully complete this Safety Certificate.

## **Safety in the Process Industries**

Dan Crowl, Michigan Tech University, 2008

Video series that introduces the application of chemical process safety technology in an actual chemical facility.

### **Introduction**

This video series entitled “Safety in the Chemical Process Industries” presents a strong introduction to the application of chemical process safety technology in an actual chemical facility. The video series is divided into roughly 30 minute segments with a total viewing time of 3.5 hours. Topics include:

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- concept of corporate safety programs
- laboratory safety inspections
- personal protective equipment
- process area safety features and procedures
- DIERS methods for characterizing runaway reactions
- equipment and methods for characterizing flammable dusts and vapors
- informal and formal safety reviews

To obtain this certificate, students view the streaming video series and then download and study the Study Guide. After watching the videos and reading the Study Guide, students must pass the online exam to successfully complete this safety certificate.

## **Risk Assessment**

Ralph W. Pike, Louisiana State University, 2008

Browser-based SACHE product that provides an overview of the methods used for risk assessment, management, and reduction with examples and exercises.

### **Introduction**

Topics focusing on the detection, prevention and mitigation of risks include:

- screening analysis techniques
- hazard and operability studies (HAZOPS)
- checklist reviews
- fault tree and event tree analysis
- preliminary hazard analysis
- chemical plume and dispersion analysis
- safety audit
- Explosion and Fire Analysis
- What-if Analysis
- Assessment of Health Effects
- Failure Modes and Effects Analysis (FMEA)
- Quantified Risk Assessment

The course material prepares students in a senior-level design course to develop the information needed in plant design (e.g., a HAZOP on a process flow diagram) or provides background to topics discussed in a process safety course. This product was also designed for practicing engineers or chemists who will be involved with risk analyses. The course material emphasizes how the methods for risk assessment, management, and reduction are related and function together.

To obtain this certificate, study the Risk Assessment self-study course (2008 SACHE Product). This course is narrated (available by clicking on a text icon). The course is distributed in a zipped file to preserve the directory structure. After unzipping the file, start the course by pointing a browser to the file index1.html in the Risk Assessment folder. After studying the materials, students must pass the online exam to successfully complete the Safety Certificate.

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## **Runaway Reactions**

Amy Theis, Fauske and Associates, 2008

CSB video and SChE products that demonstrate the potential hazards and methods for controlling runaway reactions.

### **Introduction**

This SChE Student Safety Certificate focuses on managing chemical reaction hazards, particularly runaway reactions. Chemical reactions are integral to the process industries, and it is critical that reactions be properly understood in order to handle them safely. Available resources for identifying potential runaway reactions are presented in this module as well as tools for sizing relief systems to safely control and contain these potential runaway reactions.

Three sources of information should be studied to successfully complete the test for this module:

- U.S. Chemical Safety and Hazard Investigation Board (CSB) safety video entitled “Reactive Hazards: Dangers of Uncontrolled Chemical Reactions”, dated July 31, 2007 (available through the CSB website at <http://www.csb.gov/videoroom/default.aspx?> or YouTube at <http://www.youtube.com/watch?v=sRuz9bzBrtY>)
- SChE Product “Rupture of a Nitroaniline Reactor” (2007) by Dr. Ronald Willey
- SChE module “Runaway Reaction – Experimental Characterization and Vent Sizing” (2005) by Dr. Ron Darby.

To obtain this certificate, students study the information sources above and pass the online exam to successfully complete the Safety Certificate.

## **Chemical Reactivity Hazards**

Robert Johnson, Unwin Co., 2008

Web-based SChE product that provides an overview of the basic understanding of chemical reactivity hazards, supplemented with selected issues of the Process Safety Beacon from the SChE archive.

### **Introduction**

Chemical Reactivity Hazards is a web-based SChE module that shows how uncontrolled chemical reactions can lead to serious harm. Key concepts for avoiding unintended reactions and controlling intended reactions are discussed, including:

- Three major incidents that show the potential consequences of uncontrolled reactions
- How chemical reactions get out of control, including consideration of reaction path, heat generation and removal, and people/property/environmental response
- Data and lab testing resources used to identify reactivity hazards
- Four approaches to making a facility inherently safer with respect to chemical reactivity hazards
- Strategies for designing facilities to prevent and mitigate uncontrolled chemical reactions

An extensive Glossary and Bibliography are directly accessible from any page. This web-based instructional module contains about 100 pages.

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To obtain this certificate, study the Chemical Reactivity Hazards self-study course (2005 SChE Product). The course is accessed using a Word document with a link to the web-based course and login information. Process Safety Beacons from March 2003, August 2003, December 2004, March 2005, August 2005, January 2006, and July 2006 should also be studied. After studying the materials, students must pass the online exam to successfully complete the Safety Certificate.

## **Process Safety 101**

Jon Bernardi, The Lubrizol Corporation, 2010

Information for a basic understanding of the United States process safety regulations and general chemical process safety concepts.

### **Introduction**

This certificate reviews elementary concepts related to process safety including:

- Process descriptions
- Process Safety Management (PSM)
- Mechanical integrity
- Process controls
- Flammability
- Static electricity
- Design Institute for Emergency Relief Systems (DIERS) and reliefs
- Corrosion

The American Institute for Chemical Engineers and Center for Chemical Process Safety are excellent engineering resources for this information. National Fire Protection Association (NFPA) and American Petroleum Institute (API) are also good sources, but some of these resources may not be available on the internet without cost. Some NFPA documents are available as read only documents at the NFPA web site, and the registration process to gain access is currently handled (and validated) based on an e-mail address. Other web sites (such as [www.chemicalprocessing.com](http://www.chemicalprocessing.com) and [www.eng-tips.com](http://www.eng-tips.com)) have useful information, but registrations (e-mail address) with these sites are required; these sites are particularly helpful in the area of process control (both sites) and corrosion (eng-tips).