### American Institute of Chemical Engineers

# 21<sup>st</sup> International Conference of the Center for Chemical Process Safety

**CCPS 2006** 

Held at the 2006 AIChE Spring National Meeting

April 23-27, 2006 Orlando, Florida, USA

Printed from e-media with permission by:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571 www.proceedings.com

ISBN: 978-1-60423-516-6

Some format issues inherent in the e-media version may also appear in this print version.

#### Copyright

#### Copyright ©2006

This product of the 2006 Spring National Meeting was produced for The American Institute of Chemical Engineers by Omnipress.

Duplication of this product and its content in print or digital form for the purpose of sharing with others is prohibited without permission from The American Institute of Chemical Engineers and Omnipress. Also, copying this product's instructions and/or designs for use on future digital products is prohibited without written permission from Omnipress. Omnipress does not have any copyright or ownership of the actual content (documents/papers).

In no event will Omnipress or its suppliers be liable for any consequential or incidental damages to your hardware or other software resulting from the use of this product.

AIChE has been granted permission for itself and its designated agents to reproduce, sell, or distribute the papers contained herein. Copyrights to these papers are retained by the author(s) and/or employer(s), from whom permission to reproduce must be obtained. Please note that the rights to papers authored by employees or contractors of the U.S government may differ.

### American Institute of Chemical Engineers

# 21st International Conference of the Center for Chemical Process Safety 2006

## **TABLE OF CONTENTS**

Cochairs: Erdem A. Ural, PhD, James R. Thompson
Keynote Address, Process Safety in the Global Chemical Industry
Keynote Address, Process Safety in the Global Petroleum Industry (N/A)
Expanding Role of the Loss Prevention Professional, Past, Present and Future
Session 33 - Panel Discussion: Process Safety Requirements and Conducting Business in Foreign Countries Chair: Shakeel Kadri
Session 52 - Cultivating a Global Process Safety Culture Chair: Bob Conger
Considerations on Creating a Total Safety Culture in a Latin American Country (N/A) 15 Raul Mora
How to Make Problem Customers an Asset? Process Safety Challenges When Working with Diverse Customers
The Next Generation of Chemical Process Safety: a Comparison with the Nuclear Industry
Session 69 - Synergies between Process Safety and Security Chair: Monica Stiglich
Expanding Known Process Safety and Risk Analysis Concepts to Manage Security Concerns  Don Abrahamson, Adrian Sepeda
The Problem of Likelihood: Keeping Uncertainty from Undermining Security  Decisions (N/A)
Dhs Overview of Comprehensive Risk Reviews and Ramcap (N/A)
Session 72 - Global Congress on Process Safety Poster Session Chair: Karen Person
Disseminating Critical Safety and Hazard Information to a Global Audience (N/A) 40 Christina Pierce

Why Mechanical Integrity Is So Tough (N/A)	41
Self-Heating of Heat Transfer Fluids in Porous Insulation (N/A)	42
Recommended Leading Safety Indicators for the Fire Protection Industry	43
Session 73 - Building on Lessons Learned Chair: Don Connolley	
The Inclusion of Construction Trailers and Modular Buildings in Siting Studies (for CCPS)	44
Six Sigma Fire & Explosion Reduction Project	45
Tracing Source of Ethylene Oxide Gas House Explosion Using Damage Indicators and Thermal Modeling	46
Session 108 - Hazardous Materials Issues Chair: Peter N. Lodal	
Layer of Protection Analysis: Selecting Cost Effective Safety Measures	62
Assessing the Inherent Safety of Substances: Precursors or Hazardous Products in the Loss of Control of Chemical Systems  Valerio Cozzani, Federica Barontini, Severino Zanelli	96
Development of Hazardous Material Compatibility Storage Guideline and Tool	113
Impact of Failure Data Especialization in Quantitative Risk Assessment of Process Plants	125
Antonio Carlos de Oliveira Ribeiro, Paulo Fernando F. Frutuoso-e-Melo	
<b>Session 125 - Process Safety of Lng Production, Transporation and Distribution Chair:</b> Dave Jones	I
The Effects of Uncertainty on Quanitified Risk Assessment for Lng Facilities	155
Lessons Learned from the Application of Risk Management in the Shipment of Lng (for CCPS)	168
LNG Security Vulnerability Assessment  Dave A. Moore, David A. Jones, Michael Hazzan	180
Session 148 - International Trends in Process Safety Chair: Craig Matthiessen	
Differences in European States' Application of the Seveso 2 Directive on Major Accident Hazards  Richard Gowland	202

A Comparison between the Implementations of Risk Regulations in The Netherlands and France under the Framework of the EC SEVESO II Directive	207
The Integration of Dow's Fire and Explosion Index into Process Design and Optimization to Achieve Inherently Safer Design	225
Session 160 - Global Approaches to Inherently Safer Technology and Human FaChair: Karen Person	ectors
Incorporation of Inherent Safety Principles in Process Safety Management	232
Human Factor Considerations for Process Safety in a Global Economy	265
A Multi-Criteria and Fuzzy Logic Based Approach for the Relative Assessment of Chemical Substances Hazards	276
Session 195 - Risk Assessment I Chair: Gregory Keeports	
Lopa Application, Organization and Outcomes in the Food Processing Industry (N/A)  Colin Howat	288
Process Business Riska Methodology for Assessing and Mitigating the Financial Impact of Process Plant Accidents	289
Simplify Ehs Decision Making: Risk-Based Decision Support Tools	309
Risk Curves: a Comprehensive Program Package for Performing a Quantitative Risk Assessment  B.F.P van het Veld, H. Boot, F. Kootstra	327
Session 212 - CCPS Panel: Lessons Learned from Natural Disasters Chair: Karen Tacredi	
Session 230 - Joint Case Histories and Lessons Learned	
CSB Investigation of the Explosions and Fire at the BP Texas City Refinery on March 23, 2005	345
Don Holmstrom, Francisco Altamirano, Johnnie Banks, Giby Joseph, Mark Kaszniak, Cheryl MacKenzie, Reepa Shroff, Hillary Cohen, Stephen Wallace	
Lessons from Texas City: A Case History	356
The Accident in Bhopal: Observations 20 Years Later  Ronald J. Willey, Dennis Hendershot, Scott Berger	376

### **Author Index**