

Global Congress on Process Safety 2017

Topical Conference at the 2017 AIChE Spring Meeting and
13th Global Congress on Process Safety

San Antonio, Texas, USA
26 - 30 March 2017

Volume 1 of 3

ISBN: 978-1-5108-4135-2

Printed from e-media with permission by:

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



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

Copyright© (2017) by AIChE
All rights reserved.

Printed by Curran Associates, Inc. (2017)

For permission requests, please contact AIChE
at the address below.

AIChE
120 Wall Street, FL 23
New York, NY 10005-4020

Phone: (800) 242-4363
Fax: (203) 775-5177

www.aiche.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

(1a) AGILE Award Keynote Address	1
<i>John Televantos</i>	
(7a) Big Data Analytics Skills - a Revolution Lacking in Revolutionaries	2
<i>Lloyd Colegrove, James Peters</i>	
(7b) Achieving the Next Level of Asset Integrity with Predictive Maintenance	3
<i>Carl March, Malte Hippe</i>	
(8a) Reducing Process Safety Events - An Approach Proven By Sustainable Results	11
<i>Sheila F. Van Geffen, John W. Champion, Kevin Shaughnessy</i>	
(8b) Building a Group Process Safety Management System for a Non-Chemical Industry	38
<i>Marc Massant</i>	
(8c) How Culture Effects the Implementation of Process Safety Program Elements	73
<i>Michael Hazzan</i>	
(11a) Data Visualization Connecting Big Data to Integrate Every Level of the Organization- Messaging, Action and Opportunities!	84
<i>John DeGiovanni</i>	
(11b) Leadership in Catastrophic Incident Prevention - Using Organizational Data to Assess and Respond to High Reliability Loss Prevention Precursors	85
<i>Michael Snyder</i>	
(11c) Addressing the Dissonance Between Corporate and Individual Process Safety Drivers	96
<i>Angus Keddle</i>	
(14a) Recipe for a Complete Process Hazard Analysis - Especially Addressing the Key Demands from US CSB	110
<i>Revonda Tew, William Bridges</i>	
(14b) When the Fail Open Valve Fails Closed: Lessons from Investigating the "Impossible"	143
<i>Sean J. Dee, Russell Ogle, Brenton L. Cox</i>	
(14c) Process Hazard Analysis - Are Studies in Itself Good Enough to Reduce Risk?	158
<i>Palaniappan Chidambaram</i>	
(16a) La Divulgación a Las Partes Interesadas Elemento Clave De Las Estrategias De Seguridad De Proceso. Experiencias De Aprendizaje En Latinoamérica	166
<i>Nestor H. Sposito, Iris R Poffo</i>	
(16b) Aplicación De Seguridad De Procesos En Las Operaciones De Transporte Aéreo Del Sistema De Transporte Por Ductos Del Proyecto Camisea	185
<i>Johnny Palma Aguiar Sr.</i>	
(16c) Sistema Integral De Formación Operativa - Sifo - Seguridad Operativa En Plantas - Gestión Del Conocimiento	186
<i>Luis Alfredo Saavedra Sr., Leonel Saez Sr., Omar Cipolla Sr.</i>	
(17a) Dan Crowl on Fire - Basics of Flammability Dan Crowl	187
<i>Daniel A. Crowl</i>	
(17b) How Do Flame Arresters Work?	188
<i>Matthew Barfield</i>	
(17c) BLEVE Basics, A Primer on Boiling Liquid Expanding Vapor Explosions	189
<i>Adrian Pierorazio</i>	
(19a) Big Data Vs. Little's Law: A Systems-Based Framework Changing the Risk-Reward of Large Scale Facilities	190
<i>John Carrier</i>	
(19b) Big Data Doesn't Necessarily Mean Big Intelligence	191
<i>Mike Bearrow</i>	
(22a) Ensuring Learning (Not Just Training) - Measuring the Impact of Learning on Business Performance	192
<i>Alfonsius Ariawan, Lawrence S. Short</i>	
(56l) Tridimensional Training Matrix to Improve Process Safety Performance and Assure All Organization Involved in PSM Implementation	198
<i>Americo Diniz Carvalho Neto, Isadora Correa, Alex Alves Franca, Cristina Maretti Dias, Fabiano Fiscina, Paul Franco Brandao, Thaiane Duarte</i>	
(22c) Experiences in Development and Deployment of a Process Safety Curriculum in a North American Pipeline Company	208
<i>Ruth Uy, Eli Vilorio</i>	
(25a) Large Scale Flammability and Explosivity Testing of Low Burning Velocity Gases: Validity of Prediction Tools and Impact on Siting Studies and Risk Assessments	209
<i>Scott Davis, Kees van Wingerden, Tom DeBold, John Pagliaro, Matthijs van Wingerden</i>	
(25b) Hydrogen Jet Vapor Cloud Explosion: A Model for Predicting Blast Size and Application to Risk Assessment	231
<i>Derek Miller, J. Kelly Thomas, Simon Jallais, Elena Vyazmina</i>	
(25c) Aerosol Generation Approach and Aerosol Combustion Behavior Study	255
<i>M. Sam Mannan, Shuai Yuan, Yogesh Koirala, Chad V. Mashuga, Zhengdong Cheng</i>	
(30a) Meeting the Future Organizational and Technical Training Challenges of a Changing Workforce	274
<i>Stewart Behie</i>	

(30b) How Sustainable Is Safety - A Case Comprehension	287
<i>Chris (Kumar) Israni, Liam Doyle</i>	
(30c) Are Our Current Safety Challenges Different Than 1974 or 1984? Have We Really Learnt from Accidents? Where Are the Gaps, What Are We Missing and Why? Learn What We Have Not Learnt in Last 40 Years, Keptrepeating the Same Mistakes	294
<i>Rajender Dahiya</i>	
(31a) Aplicación De Las Alarmas Criticas De Proceso (CON Respuesta del Operador) En Las Industrias De Alto Riesgo	295
<i>Ana María Macías Juárez, Rufino Perea Lorenzo</i>	
(31b) Emergency Management - From Response to Prevention and Process Safety Elements	296
<i>Nestor H. Sposito, Dean Larson</i>	
(31c) Uso De Dos Técnicas PHA Para Identificar y Tratar Los Riesgos De Incendio, explosión y BLEVE En Una Vasija De Almacenamiento De Propano	311
<i>Jaime E. Cadena, John Ramirez</i>	
(32a) A Proposal for Improving the Efficiency, Effectiveness, Quality, and Usefulness of PHA Identification of Controls	312
<i>Keith Lennon</i>	
(32b) Cost-Effective Human Factors Tools to Reduce Plant Costs and the Risk of Injuries	313
<i>Dennis Attwood</i>	
(32c) Selection of Cases for Atmospheric Dispersion Modeling	327
<i>Thuc Ngo, Zubin Kumana</i>	
(33a) Last Line of Defense - Improving Our Step Back 5x5	328
<i>Simon Roberts, TJ Larkin</i>	
(33b) A Statistical Approach for Using Test and Inspection Results to Adjust Maintenance Strategies	329
<i>William Bradshaw, Jan Wagner</i>	
(33c) Using Data-Based Indicators to Improve Process Safety Performance	344
<i>Erin Collins, Paul Amico</i>	
(38a) A Data-Driven Early Warning System for Mining Accidents	362
<i>Yu Luo, Ashutosh Nanda, Shivaram Rajgopal, Vinay Ramesh, Venkat Venkatasubramanian, Zhizun Zhang</i>	
(38b) New Ways to Visualize and Consolidate Alarm Management KPIs	363
<i>Leandro Pinto Sr., Vanessa Conz</i>	
(38c) A Simple Way to Calculate Control Loop Service Factor Taking in Account Plant Conditionals	364
<i>Leandro Pinto Sr., Erica R. P. Claro</i>	
(43a) Elongated VCE Blast Waves and Structural Damage	365
<i>Jihui Geng, Thomas Mander, J. Kelly Thomas, Quentin A. Baker</i>	
(43b) The Nature of Ammonium Nitrate Decomposition and Explosions	389
<i>Ronald J. Willey</i>	
(43c) Calorimetry and Thermo-Kinetic Modeling to Determine SAPT and Safe Shipping Conditions for Self- Reactive Materials	404
<i>Min Sheng, Steve Horsch, Florin Dan, Robert Bellair, Marabeth Holsinger, Stephan Weinberg, Alan Sopchik</i>	
(45a) Major Accidents: Managing the First 96 Hours	429
<i>Mark Farley</i>	
(45b) Incident Management System for a Global Company - Lessons Learned	434
<i>Justin Trice, Mike Bearrow</i>	
(45c) Human Error. a Myth Eclipsing Real Causes	435
<i>Mike Broadribb, Ignacio Alonso</i>	
(48a) Prevención De Eventos Catastróficos Mediante Análisis De Causas Comunes	445
<i>Jose Villarreal, Luis Jaimes</i>	
(48b) LOPA: Ventajas De La Buena Gestión De Las Capas De Protección	452
<i>Ana María Macías Juárez, Rufino Perea Lorenzo</i>	
(48c) Learning from the Experience - Investigation and Analysis of a Boiler Explosion Shared by an Insurance Company	453
<i>Juan Medina Fernandez</i>	
(49a) Best Practices for Writing Operating Procedures and Trouble-Shooting Guides	461
<i>William Bridges, Revonda Tew</i>	
(173a) Process Safety Management: It's Not Just for Chemical Plants!	486
<i>Richard Samie</i>	
(49c) Hit the Ground Running (Safely): Process Safety for the Early Career Engineer	487
<i>Donald J. Connolly, Jerry J. Forest, Amy Gray</i>	
(50a) Dow Laboratory Safety Academy: Improving Awareness of Reactive Chemicals Hazards and Preventing Incidents	496
<i>Marabeth Holsinger, Lori Seiler, Pankaj Gupta</i>	
(50c) Safety and Asset Integrity Excellence - Using Data and Analytics to Control Composite Risk and Add Operating Value	497
<i>Eric Lavelle, Brian Dickerson, Robert Kauer</i>	
(57a) What if PHAs Included an Analysis of Human Error?	513
<i>Jeanne Curcio</i>	
(56a) Use of FEMA to Prioritize PS Incident Reduction Measures	524
<i>Florine Vincik</i>	

(56b) Is the Cost of Implementing the IEC 61511 Safety Lifecycle Justifiable?	527
<i>Michael Scott, Taylor Schuler</i>	
(56e) Large Scale Surrogate Modelling for Enhancement of Consequence Modelling of Industrial Fires	528
<i>Yoke Yuan Loy, Gade Pandu Rangaiah, Lakshminarayanan Samavedham</i>	
(56h) Enhanced Process Safety Management System	536
<i>Ahmad Aladasani, Qutaiba Okasha, Ali Ameen</i>	
(56i) Analysing Effect of Various Parameters on Maximum Surge Pressure in a Pipeline and Deciding Governing Parameter Using Statistical Approach	552
<i>Prajakta Joshi, Gaurav Bhende</i>	
(56j) Black Swans and Meteors - "Worst Case Scenarios" and Why We Need to Ignore Them	553
<i>Maria Vega-Westhoff, Michael S. Schmidt</i>	
(56m) Finding and Presenting Latent Causes of Small Incidents and Near Misses	574
<i>John Michael Munsil</i>	
(56n) Retrograde and Phase Change (RPC) Flow Considerations for Relief and Flare Systems	575
<i>Georges Melhem</i>	
(56o) Probabilistic Risk Assessment Tool Applied in Facility Layout Optimization	579
<i>Cassio Brunoro Ahumada, Noor Quddus, M. Sam Mannan</i>	
(56p) Over Conservatism in Relief Analysis	580
<i>Shailesh Saraykar, James Brigman</i>	
(56r) Protective Construction Options for Multi-Purpose Buildings with Explosion Hazards	581
<i>Mark Whitney</i>	
(56s) Job Roles and Behavioral Based Safety	582
<i>Darwin Logerot</i>	
(56t) Risk Based Process Safety: Adopting a Differentiated Approach for Managing Risks and Reducing Process Incidents	585
<i>Srinivasan Ramabhadran Sr.</i>	
(56u) An Understanding of Hazards Analysis Using LOPA for Plants Handling and Processing Combustible Dust Products	586
<i>Konanur Manjunath, Glenn W. Baldwin, James F. Koch</i>	
(57aa) Thermal Decomposition of Mono-Nitrated Toluene (MNT) with Additives	587
<i>Wen Zhu, Chad Mashuga</i>	
(57ab) Addressing Challenges of Controlling Change By Implementing Best MOC Practices	588
<i>Annant Srivastava, Laura Geerlings</i>	
(57ad) Process Change Impact on Relief System Design	589
<i>James Brigman, Shailesh Saraykar</i>	
(57ae) Identification and Local Impact Analysis of Projectile Hazard in the LNG Industry	590
<i>Prerna Jain, Wimberly Dick, David A. Rosenberg, Andrew Kohout</i>	
(57ag) Thermal Hazard Analysis and Chemical Incompatibility Tests with Custom High-Pressure Crucibles Made from Commonly Used Metals and Alloys	591
<i>Han Xia, Joan F. Brennecke</i>	
(57ah) Do Dust Hazards Analysis (DHA) Really Differ from a Process Hazards Analysis (PHA) or a Process Analysis (PA)?	592
<i>Michael E. Robertson</i>	
(57ai) A Leading Indicators Based Decision Support Tool to Predict Blowout Events	602
<i>Nafiz Tamim, Delphine Laboureur, A. Rashid Hasan, M. Sam Mannan</i>	
(57am) Consequence Modeling at the Eastman Kingsport Site	603
<i>Michael D. James, David Skelton</i>	
(57ao) Relief Systems Design: The Importance of Accounting for Static Head	630
<i>Nicholas N. Cristea, Zubin Kumana, Guomin Wang</i>	
(57aq) Study of Factors That Affect Dust Explosion Characteristics of Fibrous Dust Materials	638
<i>Bharatvaaj Ravi, Yan-Ru Lin, Chad Mashuga, M. Mannan</i>	
(57ar) High Integrity Pressure Protection System (HIPPS) and Implementation Challenges	639
<i>Janardhanan Kallambettu</i>	
(57as) Managing Risk Associated w/ Electrical Energy Ignition Sources	664
<i>Jim Johnston</i>	
(57at) Review and Analysis of Recent Cyber Security Attacks	665
<i>Ursula Malczewski, Amy Theis</i>	
(57au) Resilience-Based Survival Analysis in the Event of a Process Upset: A Case Study of Utility Plant	666
<i>Prerna Jain, Efstratios N. Pistikopoulos, Sam Mannan</i>	
(57aw) Model-Based Pressure Relief Design for Reactive Systems	667
<i>Michelle Murphy</i>	
(57ax) Dynamic Modeling of Inbreathing Requirements for Low-Pressure Storage Tanks	668
<i>Dona Chakra, Georges Melhem, Ronald J. Willey</i>	
(57az) Studying the Relationship Between Inherently Safer Design and Equipment Reliability	689
<i>Nilesh Ade, Guanlan Liu, Sam Mannan</i>	
(57b) Pressure Relief Analysis - It's about More Than Just Compliance	690
<i>Robert Siml, Alysson Ferreira</i>	
(57ba) How to Leverage Limited Design Data Along with Historical Incident Data to Assess Inherent Process Safety During Early Stage of Design?	691
<i>Fadwa T. Eljack, Monzure-Khoda Kazi, Ahmed AlNouss</i>	

(57bb) Inherently Safer Design from Overpressure Protection Viewpoint	692
<i>Nancy Faulk, Christopher Ng, Sachin Kanade</i>	
(57bc) Three Reasons Major Event Risk Management Fails on Capital Project	701
<i>Denise Chastain-Knight</i>	
(57bd) Safety Rating System Based on Current Situation of China Petrochemical Enterprises	714
<i>Linlin Wang</i>	
(57bf) The Difficulty and Prospect of the Development of Quantitative Assessment Technology in the Field of Chemical Safety in China	723
<i>Jiu Jiangbo</i>	
(57bg) Recipe for a Sizzling HAZOP	724
<i>Angus Keddie</i>	

VOLUME 2

(57bi) Bridging the Divide - OHS and Process Safety	733
<i>Trish Kerin</i>	
(57bk) 20 Years of Personal Process Safety Lessons	734
<i>Steve Streblov</i>	
(57bl) Identifying Opportunities of Enhancing Safeguard Stewardship through IPL Rationalization	745
<i>SreeRaj Nair, Bernadette Thornton</i>	
(57bm) Process Safety Site Assessment Program (PSSAP) - 5 Years of Assessments	754
<i>Andrew Broadbent</i>	
(57bn) Alarm Management Meets SIS	763
<i>Darwin Logerot</i>	
(57bq) Enhancing Process Safety Management Integration to Improve Process Safety and Profitability in the Fuels and Petrochemicals Industry	764
<i>Thomas D. Watson, Harold Phillippi, Ronald Fuchs</i>	
(57br) Reactive Hazards Management: Lessons Learnt from Major Incidents	773
<i>Robert Weber, Sonny Sachdeva</i>	
(57bu) The Study of Safety Evaluation Technique for High Temperature Process	774
<i>Manabu Okuyama</i>	
(57bv) Handling Uncertainty in LOPA and SIF Design	775
<i>Arjan Abeynaïke, Venkatesh Sourirajan, Akshat Khirwal</i>	
(57bw) Fundamental Research at Purdue Process Safety Research Center	788
<i>Ray A. Mentzer</i>	
(57by) Bringing New Life to Process Safety	789
<i>Farshad Hendi, Steve Elliott</i>	
(57cb) Developing an Effective System for Action Item Resolution	790
<i>Zubin Kumana, Jason F. White</i>	
(57cc) Where Does Management of Change (MOC) Begin?	791
<i>Juliana Schmitz, Patti Jones, Gabriel Drummond</i>	
(57cd) Effectively Utilizing Calarp/RMP/PSM Contractors to Assist in Optimizing Process Safety Culture, Compliance with Standards, and Workforce Involvement	801
<i>Ivan Cheng, Timothy Lee, Steven T. Maher, Michael Saura</i>	
(57ce) A Streamlined Approach for Full Compliance with SIL Implementation Standards	802
<i>William Bridges, Art Dowell III</i>	
(57cg) The Art of the Audit: Being Audit Ready, Everyday	814
<i>Amanda Scalza, Brady Brown</i>	
(57ck) Economic Justification for Better Maintenance in a Safety System	815
<i>William M. Goble, Loren Stewart</i>	
(57cl) How Important Is Realistic Failure Rates for Safety Instrumented Functions?	816
<i>John Day, Loren Stewart</i>	
(57cn) Enabling Sustainable Relief System Management Programs through Independent Reviews	817
<i>Aniket Patankar, Norberto Pineda</i>	
(57f) Jack Rabbit II: Experimental Large-Scale Chlorine Release Trials	818
<i>Shannon B. Fox, Thomas O. Spicer III, Leo Stockham, Mark Whitmire, Ronald Meris, Thomas Mazzola, Joseph Chang, Steven Hanna, Michael Sohn, Damon Nicholson, Andy Byrnes</i>	
(57g) Functional Safety - Pitfalls and Good Practices	825
<i>Crystal James, Marisa Pierce, Chris Parr</i>	
(57i) Method for Uncertainty Evaluation of Safety Integrity Level (SIL) Calculations	826
<i>Raymond "Randy" Freeman</i>	
(57j) Comparison of Batch Versus Continuous Process in Pharmaceutical Industry Based on Safety Consideration	876
<i>Shiqi Chen, Yogesh Koirala, M. Sam Mannan</i>	
(57k) Risk Based Decision Making Methods for Evaluating Complex Technologies, a Comparative Analysis on Pipelines and Railroad for Crude Oil Transport	900
<i>Pranav Kannan, M. Sam Mannan, Martin A. Wortman</i>	
(57m) Key Modeling Parameters and Process Safety Information for Effective Atmospheric Dispersion Modeling	901
<i>Srihari K Maganti</i>	

(57n) Implementation of Hazard Mitigation Solutions: Consequence Vs. Risk-Based Building Specifications.....	902
<i>Travis Holland, Joshua Bruce-Black</i>	
(57o) Generalization of Modeling Along-Wind Dispersion.....	903
<i>Jessica M. Morris, Thomas O. Spicer III</i>	
(57p) Review and Analyze the Effects of Parameters for H₂S Gas Mixture Dispersion Models: Degadis and CFD Models.....	917
<i>Jiayong Zhu, Delphine Laboureur, M. Sam Mannan</i>	
(57s) Considerations When Justifying the Purchase of an Operator Training Simulator.....	918
<i>Ian Willetts</i>	
(57u) Consequence Analysis of Gas Explosion in Underground Common Utility Tunnels.....	919
<i>Mirae Yoo, Yuri Jang, Seungho Jung</i>	
(57v) Air Cooler Explosion Analysis Using CFD.....	920
<i>Greg R. Knight</i>	
(57w) Revisions to the QMEFS Vapor Cloud Explosion Model.....	921
<i>Jeffrey D. Marx, Benjamin Ishii</i>	
(57x) Do We Need a Quantitative Risk Assessment (QRA) If My Consequence Analysis Facility Siting Presents a Problem?.....	936
<i>Vinicius Simoes</i>	
(57y) Proposed Method for Investigating the Reactivity of Chlorine with Environmental Materials Under Relevant, Controlled Conditions.....	937
<i>Audrey Feuvrier, Thomas O. Spicer III</i>	
(57z) Fire Proofing Cost Reduction Measures for LNG Plant.....	947
<i>Raminaidu Girada, Jegan Babu Arumugakan ThuraiSwamy, Antonino Nicotra</i>	
(69a) Consideration of Escalation Risks in Facility Siting.....	958
<i>Dennis Ngai, Venkatesh Sourirajan</i>	
(69b) The Facility Siting Cycle (Revalidation).....	959
<i>Michael D. Weinberg</i>	
(69c) Strategic Facility Siting - A Different Perspective.....	968
<i>Steve Clepper, Hollie Schmidt</i>	
(71a) Depressurization of Process Equipment during Emergency or Planned Shutdown on a High Potential CO₂-Solid-Forming Stream Utilizing the Latest Dynamic Simulation and Blowdown Models.....	985
<i>Scott M. Wozniak, Fadhli Hadana Rahman, Raad Assaf, M Faudzi B Mat Isa</i>	
(71b) Inherently Safer Piping - Best Practices.....	986
<i>Steve Streblov</i>	
(71c) Understanding Tolerable Risk Criteria - Considering the Growth of LNG Transportation.....	1008
<i>Ryan J. Hart, Delmar "Trey" Morrison</i>	
(72a) A Case Study in Human Reliability - Analysis to Support LOPA in Unloading Hazardous Liquids.....	1023
<i>Delmar "Trey" Morrison, Chris Aiken, Sunil Lakhiani, Pim van der Graaf</i>	
(72b) Current State of Bow Tie Risk Assessment Method.....	1050
<i>Robin Pitblado, Charles Ian Cowley, Kiran Krishna, Tim McGrath, Mark Manton, Ron McLeod, Paul Haydock, Tatiana Norman, Martin Johnson</i>	
(72c) Barrier Thinking Using Bow Ties for Offshore Production Platforms - A Case Study.....	1066
<i>Patricia Grant, Krishna Bala, Stuart Chia, Michell Liu, Fiona Wong</i>	
(75a) Offshore Units Safety Management Systems Analysis: SGSO x SEMS II.....	1079
<i>Mauricio Longo Braz Pessanha, Marcelo Meiriño</i>	
(75b) Melhoria Em Revisão De Segurança De Pré Partida Atavés Da Utilização Da Revisão Por Sub Processos Durante o Comissionamento De Unidades De Processo.....	1097
<i>Eduardo M. Francisco, Antonio Junior, Manuel Canuto, Lucas Almeida</i>	
(75c) Avaliação Da Segurança Funcional Em Intertravamentos, Alarmes e Controles De Segurança: Quão Eficiente São Seus Projetos Em Segurança Funcional? - Functional Safety Assessments of Safety Controls, Alarms, and Interlocks: How Efficient Are Your Functional Safety Projects?.....	1108
<i>Monica Hochleitner, Eloise Roche, Angela Summers</i>	
(78a) Remember or Repeat.....	1120
<i>Alan C. Brackey</i>	
(78b) In Harm's Way - After Which Nothing was the Same Again.....	1121
<i>Mike Broadribb</i>	
(78c) How a 5 Year Old Learned About Process Safety Management.....	1122
<i>Ronald J. Willey</i>	
(79a) Simplistic Yet Insightful Way to Present Operational Risks in Order to Facilitate Risk Discussions.....	1123
<i>Alfonsius Ariawan, Donald Byrne</i>	
(79b) Uncertain about Uncertainty.....	1129
<i>John Joseph Crump</i>	
(79c) A Look into Cumulative Risk Assessment: Past, Present and Future.....	1159
<i>Syeda Zohra Halim, Yogesh Koirala, M. Sam Mannan</i>	
(86a) The Capability Engine, Analyzing the Past to Protect the Future.....	1171
<i>Alfonsius Ariawan, Lawrence S. Short</i>	
(86b) "Getting More Out of Your PHAs with Data Analytics".....	1176
<i>Allison De Man, Marisa Pierce</i>	
(86c) Prevent the Next Catastrophe.....	1177
<i>Mike Brooks</i>	

(91a) Large Scale Testing Confirms: A Deflagration to Detonation Transition Needs to be Considered in Facility Siting	1178
<i>Scott Davis, Derek M. Engel, Kees van Wingerden, John Pagliaro, Drew Botwinick, Erik Merilo, Adam Ziemba, Mark Groethe</i>	
(91b) Real World Applications of API 753	1208
<i>Darren Malik</i>	
(91c) Shrapnel-Accounting for Blast Fragments in Facility Siting Studies	1209
<i>Corey Whelehan, Michael S. Schmidt</i>	
(94a) Sustaining Process Safety During Difficult Economic Times	1223
<i>John Herber</i>	
(94b) And Now for Something Completely Different	1237
<i>Mike Broadribb</i>	
(94c) Supervisors and Mid-Managers at the Center of Safety	1249
<i>Renato Prestes, TJ Larkin</i>	
(97b) Research on Design of Comprehensive Risk Assessment System for Urban Refinery	1250
<i>Xiaoming Yan</i>	
(97c) Study on On-Line Monitoring Technology of Oil Tank Grounding	1264
<i>Pan Liu, RenJie Lou</i>	
(98a) Addressing Process Safety Challenges in Batch Tolling	1272
<i>Brenda Seggerman</i>	
(98b) A HAZOP Gap Query Approach for Hazard Assessment in Multi-Product Facilities	1293
<i>James Torres, Nick Ashley</i>	
(98c) Inherently Safer Reactor Design: Challenges in the Changeover from Semi-Batch to Continuous	1309
<i>Jingyao Wang, Maria Papadaki, M. Sam Mannan, Noor Quddus</i>	
(100a) Please, Not Again! - The Second Time Process Safety Hit Home	1324
<i>John Winckel</i>	
(100b) Lessons from the Past	1325
<i>Katherine E. Pearson</i>	
(100c) Help Assure Good PHAs by Enhancing the Sense of Vulnerability	1326
<i>Scott Berger</i>	
(111a) A Risk-Based Approach for Predicting Domino Effects Due to Fires - Combining Exceedance Curves with Thermal Stress Dynamic Analysis	1333
<i>Jordi Dunjó</i>	
(111b) Quantifying the Mass Release Rate for Flashing Two Phase Releases for Consequence Assessment Purposes	1334
<i>Thomas O. Spicer III, Derek Miller</i>	
(111c) Effectiveness of Water Sprays in Mitigating Toxic Releases	1335
<i>Samrat Mukherjee, Seshu Dharmavaram, Stephen Jaskolka</i>	
(115a) A Study of Catastrophic Incident Warning Signs to Prevent Incidents in the Yeosu Chemical Complex	1352
<i>SH Baek, Hyuckmyun Kwon</i>	
(115b) Risk Management Program (RMP) for Chemical Industry in Korea	1353
<i>Byungchol Ma, Yi Yoon, Junheon Yoon</i>	
(115c) Stochastic Programming and Atmospheric Dispersion Modeling Dispersion Modeling for Optimal Placement of Gas Detectors	1361
<i>Dongil Shin, Jaehoon Cho</i>	
(116a) Managing Risk through Integrity Operating Windows	1362
<i>F. Russ Davis</i>	
(116b) Human Reliability Analysis for Evaluation of Conduct of Operations and Training	1370
<i>Erin Collins, Bijan Najafi</i>	
(116c) Process Safety in Operations - What's Missing?	1381
<i>Mike Neill</i>	
(118a) PSM Challenges in an Aging Cyanide Plant	1394
<i>John L. Gohres, Hans E. Thullesen, William R. Zecha, Joel F. Singleton</i>	
(118b) We Built a (Process Safety) Ship – Who Is Going to Sail It in 5 Years?	1406
<i>Monica Stiglich</i>	
(118c) Changes to Industry Guidance on Relief and Flare Systems and Impact on Existing Infrastructure	1417
<i>Paul Frey, Sathish Natarajan</i>	
(119a) Effectively Addressing Damage Mechanism Reviews in a Process Hazard Analysis: A Checklist Approach	1432
<i>Tazim Rehmat, Gary Carrithers, Randal Montgomery, David Whittle, Sayed Termah</i>	
(119b) The Integration of Inherently Safer Design and Control	1451
<i>Denis Su-Feher, M. Sam Mannan, Yogesh Koirala, Efstratios Pistikopoulos</i>	

VOLUME 3

(119c) Criteria for Determining the Need for Installation of Fixed FIRE and Gas Detectors in Petroleum Refineries	1465
<i>Laurence Siqueira, Bruno F. Barsotti, Socrates Fofano</i>	
(129a) Limiting Oxygen Concentration of Hybrid Mixtures	1480
<i>Emmanuel K. Addai, Martin Clouthier, Paul R. Amyotte, Ulrich Krause</i>	
(129b) Ignitability of Combustible Dust Fueled Flash Fires with Industrial Ignition Sources	1494
<i>Michael C. Stern, Sean C. O'Hern, Alfonso Ibareta, Russell Ogle, Timothy J. Myers</i>	

(129c) A New Methodology to Evaluate System-Level Performance of Explosion Suppression Systems	1505
<i>Jenny Chao, Sergey B. Dorofeev</i>	
(137a) New Approach to Using CFD Modeling for Chlorine Releases in Seoul	1527
<i>Mini Min, Chuntak Phark, Mirae Woo, Seunggho Jung</i>	
(137b) RMP and ORA: A New Paradigm for Environmental Safety Management of Chemical Industry in Korea	1528
<i>Kyoshik Park</i>	
(137c) Cause Analysis of Recent Chemical-Accidents and Preventive Measures in Korea	1529
<i>Hyup Lee, Hyung Sub Lee, Won Baek Yang</i>	
(138a) Using PS Incident Warning Signs to Increase Hazard Awareness and Sense of Vulnerability	1530
<i>Brian Kelly, John Herber, Jerry L. Jones</i>	
(141a) Stratification During Vapor or Gas Freeing of Storage Tanks	1543
<i>Michael Hanks, Ronald Pape, Amy Richards</i>	
(141b) Refinery PHAs - Revalidation or Re-Dos? Do They Ensure Safe Operations?	1567
<i>Joshtin Cooper, Kumar Israni, Radhika Bompelly</i>	
(141c) How Small of a Cloud We Want to Detect on Our Gas Detectors?	1577
<i>Vinicius Simoes, Massimiliano Kolbe, Sarah Chambliss</i>	
(142a) Limiting OSHA's Authority to Issue Citations: Court Rejects OSHA's Efforts to Evade OSH Act Statute of Limitations by Alleging Continuing Violation	1600
<i>Mark Dreux, Alexandra M. Romero</i>	
(142b) PSM/RMP Modernization Programs in California - 2016 Developments and Correlation to Evolution at the Federal Level	1606
<i>Steven T. Maher, Aleksandar Metulev, Michael Vigliarolo, Cho Nai Cheung</i>	
(56g) Existing Challenges in Incorporating Process Safety Management in Developing Countries and Ways to Overcome Them	1630
<i>Yogesh Koirala, Andres Hernandez, M. Sam Mannan</i>	
(143a) Understanding Vapor Cloud Explosions	1640
<i>Derek Miller</i>	
(143b) Running the Gamut of Hazard Identification and Risk Analysis Methods	1641
<i>Robert W. Johnson</i>	
(143c) Q&A on QRA	1642
<i>Jeffrey D. Marx</i>	
(147a) Proven Approaches to Ensuring Operators Can Respond to Critical Process Deviations in Time (Human Response IPL)	1643
<i>William Bridges</i>	
(147b) "Closing the Holes in the Swiss Cheese Model" - Maximizing the Reliability of Operator Response to Alarms	1674
<i>Todd Stauffer, Nicholas Sands, David Strobhar</i>	
(147c) Adapting Cause and Effects Methodology to Your Safety Instrument System (SIS) to Reduce Human Errors from Engineering, Operations and Beyond	1694
<i>Charles Fialkowski</i>	
(148a) API-RP521 Psv Capacity Calculation Compared Against Universal Bernoulli's Homogeneous Equilibrium Method	1709
<i>George Maliakkal</i>	
(0c) Using Combined Failure Data Sources to Assess Equipment Failure Rates	1710
<i>Danielle Chron, Anne Østdahl</i>	
(151a) The Study of Thermal Hazard Evaluation of Polymerizing Substances at Storage	1711
<i>Motohiko Sumino, Akemi Endo</i>	
(151b) Natural Calamities and Challenges in Preventing and Mitigating Impacts in Japanese Refineries and Petrochemical Plants	1727
<i>Keisuke Kurosawa, Yuichi Kishikawa</i>	
(151c) Cyber Incident Exercise for Safety Protection in Critical Infrastructure	1728
<i>Yuitaka Ota, Tomomi Aoyama, Ichiro Koshijima</i>	
(152a) Systematic Approach to Improve Learning from Incidents	1746
<i>Juliana Guarguati Ariza, Noor Quddus, M. Sam Mannan</i>	
Leading and Lagging Indicators	1763
<i>Robert Weber, Sonny Sachdeva</i>	
(152c) Ten Years of Living Risk Based Process Safety	1795
<i>Steve Arendt, William Bradshaw, Donald K. Lorenzo, Lee N. Vanden Heuvel, Walter L. Frank, Jack McCavit</i>	
(154a) The Top Ten Reasons for Fixed Equipment Failures in the Hydrocarbon Process Industries	1806
<i>John Reynolds</i>	
(154b) Advancing Asset Integrity in Chevron Upstream	1807
<i>Vincent Attanucci, Philip Delpero, Elizabeth Leaverton</i>	
(154c) Using HAZOP/LOPA to Create an Effective Mechanical Integrity Program	1820
<i>Steven T. Maher, David J. Childs</i>	
(158a) Are Your Safeguards Fast Enough to Be Effective?	1837
<i>Eloise Roche, Angela E. Summers</i>	
(158b) Temporary Management of Change: A Problem or a Necessary Part of Managing Process Safety	1849
<i>Jody Olsen</i>	
(158c) Don't Do What We Did - Stupidity, Luck, and Making Good Choices	1876
<i>Mike Moosemiller, Kathleen A. Kas</i>	

(166b) Industrial/Academic Safety Partnership - An IChemE Case Study	1898
<i>Trish Kerin</i>	
(167a) Inherently Safer Automation	1906
<i>Angela E. Summers</i>	
(167b) CCPS Project 246 - 2nd Edition Guidelines for Siting and Layout of Facilities	1920
<i>Bruce K. Vaughen, Martin Timm, Donald J. Connolly, Charles Ian Cowley</i>	
(167c) CCPS Vision 20/20: What and How Are WE Doing?	1947
<i>Cheryl Grounds, Jack McCavit, Rukyah Hennessey</i>	
(171a) New Guidelines for Managing Asset (Mechanical) Integrity	1957
<i>Eric Freiburger, Michael P. Broadribb, John Murphy, Robert W. Johnson</i>	
(171b) Fracture Toughness and Brittle Failure - A Pressure Vessel Case Study	1973
<i>John Puryear, Guillermo Ramirez, Clint Botard, Kollin Kenady</i>	
(171c) The Use of Finite Element Method (FEM) in Modeling Effect of CO₂/H₂S Corrosion	1984
<i>Lihan Zeng, Yan-Ru Lin, M. Sam Mannan, Yan Cui</i>	
(173b) A Simplified Process Hazards Analysis (PHA) Approach Applied for Non-Covered Processes	2010
<i>Jonas Duarte</i>	
(173c) Beyond Compliance: Using PSM to Enhance the Grain Handling Standard	2025
<i>Luca Clemons, Michael S. Schmidt</i>	
(56f) Common Hurdles, Benefits, and Costs for Fully Implementing Process Safety Worldwide - Especially in Countries Without PSM Regulations	2042
<i>William Bridges, Art Dowell III, Jeff Thomas, Paul Casarez</i>	
(176a) Dust Explosion Hazards: Housekeeping Quantified	2061
<i>Richard Prugh</i>	
(176b) Implementing an Effective Management of Change (MOC) System for E&p Business and Non- PSM Facilities	2092
<i>Sandipan Laskar</i>	
(176c) Improving Human Factors Review in PHA and LOPA	2103
<i>Dave Grattan</i>	
(182a) Waste Solvents to Trash Haulers: Lessons Learned from Hazardous Waste Accidents	2125
<i>Delmar "Trey" Morrison, Michael Stern, Carmen Osorio-Amado</i>	
(182b) ExxonMobil Torrance Refinery FCC ESP Explosion	2153
<i>Mark Wingard</i>	
(182c) Overfill to Overpressure - Investigation Findings and Contributing Events to the Capeco Explosion	2154
<i>Scott Davis, Tom DeBold, Bryant Hendrickson, Claudio Marsegan</i>	
(182d) Produced Water Tank Explosion Case Study	2175
<i>J. Kelly Thomas</i>	
(182e) Milestone Company Incidents and Their Impact on Air Products Process Safety Journey	2190
<i>Brian E Farrell</i>	
(182f) Plymouth Incident	2191
<i>Von Studer</i>	
Author Index	