Exponent®
Engineering & Scientific Consulting

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Professional Profile

Dr. Morrison applies his expertise as a chemical engineer to provide technical consulting services for a variety of industries including consumer products, industrial equipment, agricultural and food processing, chemical manufacturing, and oil and gas. For over twenty-five years, he has analyzed a multitude of products, equipment, systems and processes to aid stakeholders including owners, manufacturers, and insurers through incident investigation, fire and explosion investigation, root cause analysis, and evaluation and mitigation of risks.

Dr. Morrison is active in the product safety and chemical process safety communities through standards (NFPA, UL) and technical (LPS, PSMM) committee participation, presentations, and publications. He serves in leadership roles in the field of chemical process safety through conferences sponsored by AIChE in North America and in Latin America. Dr. Morrison has been presented as an expert and advised clients in various adjudicatory venues including federal court, state court, mediation, and international arbitration.

FIRES, EXPLOSIONS, AND HAZARDOUS RELEASES

Dr. Morrison’s investigations encompass all magnitudes of incidents in numerous industry sectors, from consumer product-related incidents to industrial chemical process plant releases. Dr. Morrison has investigated hazardous releases, fires, combustion explosions, and mechanical overpressure explosions in various settings spanning from domestic residential origin and cause investigations to international industrial fire and explosion investigations. His analyses have focused on applying the underlying physics, chemistry, and engineering science principles as an integral part of the multidisciplinary scientific investigation of energetic incidents.

Dr. Morrison's practical research encompasses self-heating materials and reactive chemical hazards by evaluating scenarios such as spontaneous ignition of vegetable oil-contaminated fabrics in a laundry setting and thermal runaway of reactive chemicals in an industrial setting. His work has often employed calculation, modeling, and laboratory testing to evaluate evidence and test hypotheses.

WORKPLACE SAFETY, PROCESS SAFETY AND RISK ANALYSIS

Dr. Morrison is a Certified Process Safety Professional through CCPS. His work in industrial settings has been both proactive – aiding clients in identifying and managing risks – and reactive – investigating the root causes of complex incidents. He leverages his expertise in over twenty years of incident investigation to lead clients in both traditional and specialized hazard and risk analysis techniques. Dr. Morrison has led hazard and risk assessments using industry-accepted process hazard analysis (PHA) methods including HAZOP studies, What-If studies, and LOPA studies, combined with analytical techniques such as Fault Tree Analysis, Event Tree Analysis, Human Reliability Analysis, Root Cause Analysis, Consequence Analysis, Transportation Risk Analysis, and Quantitative Risk Assessment.

Dr. Morrison often assists clients with evaluating and improving their process safety management systems through application of industry best practices, OSHA PSM, and CCPS Risk Based Process Safety principles. Dr. Morrison's expertise bridges personal workplace safety and process safety. He also investigates workplace safety incidents involving permit to work activities such as Lock Out/Tag Out (LOTO), hot work, and confined space entry.

PROCESS DESIGN AND PERFORMANCE

Dr. Morrison has analyzed a variety of process plants, their processing units, and associated maintenance and operating activities to evaluate performance against recommended and generally accepted good engineering practices (RAGAGEP), owner's requirements, and designer's specifications. He has worked with processes ranging from pharmaceutical processes, mineral extraction and processing, food and agricultural processes, to oil, gas, and LNG. Dr. Morrison's areas of analysis have commonly included chemical process design, process scale-up, process engineering, process control, and process performance analysis.

Given the variety of process technologies that he has studied, he has also developed expertise in supporting equipment that is integral in the handling, conveying, and storage of liquids, gases, and solids as feeds, intermediates, and products of processes. For example, he has analyzed solids material handling systems including belt conveyors, belt/drag conveyors (horizontal, L-, S-, and Z-type), screw conveyors, elevators, silos, bins, and hoppers; dust analysis, characterization, conveying, collection, and handling systems; chemical reactor technology, arc furnace technology; fluid handling systems including piping, pumps, valves, mixing, separations, heat exchangers, vessels, and tanks; and process operations (both manual and automatic computer controlled), human operators involvement, training, and oversight.

SAFETY OF PRODUCTS AND EQUIPMENT

Dr. Morrison has used his expertise in systems safety and failure analysis to evaluate reliability and failure modes in consumer products and industrial equipment. His work has assisted clients in the product development stage, incident investigation, and through product recall analysis and consulting. Dr. Morrison has advised clients on consumer product forced failure analysis, flammability, and fire containment strategies and on industrial equipment safety devices and safeguard management. He has assisted client teams through RCA and FMEA studies for new products and to evaluate the risks of legacy products. He has particular expertise in heating systems including residential and commercial clothes dryers and industrial process dryers, ovens, and furnaces. He has also focused on oil-flooded screw air compressors and other major industrial equipment failures.

Dr. Morrison's publications list and examples of project experience are provided at the end of this curriculum vitae.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, Illinois Institute of Technology (IIT), 2008

M.S., Chemical Engineering, Oklahoma State University, 1998

B.A., Chemistry, Knox College, 1997

Fellow of the American Institute of Chemical Engineers

Licenses and Certifications

Professional Engineer, Georgia, #PE046320

Professional Engineer, Illinois, #62059506

Professional Engineer Chemical, Iowa, #P22945

Professional Engineer, Michigan, #6201062901

Professional Engineer, North Carolina, #37722

Professional Engineer, Pennsylvania, #PE046320

Professional Engineer, South Carolina, #28918

Professional Engineer Chemical, Texas, #133719

Certified Process Safety Professional (CCPSC)

Certified Fire and Explosion Investigator (CFEI)

Professional Affiliations

Process Safety

• Session Chair for Battery Safety, 2025 Loss Prevention Symposium

• Session Chair for Loss Prevention Symposium Tutorials, 2025 Process Safety Management Mentoring Symposium

• Session Chair for Combustible Dust Hazards, 2024 10th Latin American Conference on Process Safety

• Session Chair for Alternative Energy Infrastructure, 2024 Loss Prevention Symposium

• Session Chair for Facility Siting, Consequence Analysis, and Risk Assessment, 2023 Loss Prevention Symposium

• American Institute of Chemical Engineers (Fellow)

• AIChE CCPS Technical Steering Committee

• Member of the American Institute of Chemical Engineers (AIChE) Loss Prevention and Process Safety Programming Committee (Area 11a of the AIChE Safety & Health Division)

Fire Safety

- National Fire Protection Association (member)
- National Association of Fire Investigators (member)
- Principal Member: Technical Committee on Ovens and Furnaces, NFPA 86 Standard for Ovens and Furnaces, National Fire Protection Association

Product Safety

- Member of Underwriters Laboratories Standards Technical Panel (STP) 2157 covering the following Standards for Safety: ANSI/UL 1206 Electric Commercial Clothes-Washing Equipment,

ANSI/UL 1240 Electric Commercial Clothes-Drying Equipment, ANSI/UL 2157, Electric Clothes Washing Machines and Extractors, and ANSI/UL 2158 Electric Clothes Dryers

Past Professional Affiliations/Positions

Process Safety

During his career, Dr. Morrison has chaired many process safety conference sessions, collaborated on manuscripts and presentations, and taught selected topics covering the following and similar areas of interest. The objectives of these activities are to aid in the prevention of major loss incidents that involve fires, explosions, runaway reactions, and hazardous material releases in the chemical, petrochemical, and related industries.

• Process Safety and Process Safety Management

• Fires, Explosions, Toxic Releases, and Reactive Chemicals - Consequences, Hazards, and Risks

• LNG & LPG Safety, Hazards, and Risks

• Incident Investigation, Root Cause Analysis, and Lessons Learned

• Human Factors and Human Reliability in Process Safety

• Indicators and Key Performance Metrics in Process Safety

• Mechanical Integrity, Pressure Relief and Safety Instrumented Systems

Leadership positions of special note have included the following:

• Safety & Health Division of AIChE (Director 2021-2023)

• Conference Chair for the 7th CCPS Latin American Conference on Process Safety in 2016

• Symposium Chair for 5th Process Safety Management Mentoring (PSM2) Forum in 2016

• Chair of the AIChE Loss Prevention and Process Safety Programming Committee for 2012-2013

• Global Congress Chair for the 2012 8th AIChE Global Congress on Process Safety in 2012

• Symposium Chair for the 45th AIChE Loss Prevention Symposium in 2011

Product Safety

• Member of Underwriters Laboratories Task Group for Clothes Dryer Exhaust Duct Power Ventilators

• Member of Underwriters Laboratories Task Group to Address Requirements for Clothes Dryer Status Indicators

Publications

Morrison Delmar “Trey” R., Cox BL, Mastalski I. Explosion of a cooling tower dosing system. Process Safety Progress, 2025;1-7. doi:10.1002/prs.70017

Cox BL, Schulman NS, Morrison DR. Blue skies, green risk matrices: Managing the hazards associated with air pollution control equipment. Process Safety Progress 2025; 1-8. DOI: 10.1002/prs.70011.

Reding N, Ibarreta A, Wechsung A, Hart R, Morrison D. Blended natural gas/hydrogen fuel gas systems: An evaluation of risk. Process Safety Progress 2025; 1-7. DOI: 10.1002/prs.12677.

Lardinois T, Morrison DR, Revez D. An unexpected explosion while fumigating a grain silo: It wasn't the dust. Process Safety Progress 2023 Sep 42:S1, S97-S102.

Kas K, Morrison DR. It was a dark and stormy night—Investigation of acrylate storage tank explosions. Process Safety Progress 2022 Jun 41:2, 293-306.

Coelho CJ, Lakhiani SD, Morrison DR. Human Fatigue Risk Management in Workplace Settings: Implications for Litigation. Defense News, Vol II 2021. 11-13. DTCWV Defender, Winter 2021; 5-8. Common Defense, Spring/Summer 2020; 28-31.

Coelho CJ, Lakhiani SD, Morrison DR. Stay Alert: Incorporate Fatigue into Risk Management. Chemical Engineering Progress 2020 Jan; 40-45.

Morrison DR, Hart RJ, Reed M, Peterson E. Is your hot work safety zone actually safe? Chemical Engineering Progress 2019 Jan; 52-58.

Morrison DR, Stern M, Osorio-Amado CH. Waste Solvents to Trash Haulers: Lessons Learned from Hazardous Waste Accidents. Process Safety Progress 2018; 37(3):427-441.

Morrison DR, Stern M, Osorio-Amado CH. Handle Hazardous Waste Safely. Chemical Engineering Progress 2018 Apr; 42-47.

Ibarreta AF, Hart RJ, Ponchaut NF, Morrison DR, Kytömaa HK. How does concrete affect evaporation of cryogenic liquids: Evaluating liquefied natural gas plant safety. ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems Part B: Mechanical Engineering 2016; 2(1):011005-1-5.

Morrison DR. Separating anecdotes from science in low temperature ignition of wood. MDTC eNewsletter (http://www.mdtc.org/Articles/2015/June/Separating-Anecdotes-from-Science-in-Low-Tempera.aspx), posted June 2, 2015.

Ibarreta AF, Morrison DR, Kytömaa HK. Small scale and transportation: navigating the risk. LNG Industry Magazine 2014 Oct; 17-24.Cox BL, Dee SJ, Hart RJ, Morrison DR. Development of a steel component combustion model for fires involving pure oxygen systems. Process Safety Progress 2014; 33(3):299-304.

McInerney EH, Hart RJ, Morrison DR, Kytömaa HK. New quantitative risk criteria for US LNG facilities. Process Safety Progress 2014; 33(3):237-246.

Ibarreta AF, Ponchaut NF, Hart RJ, Morrison DR, Kytömaa HK. Using passive methods to reduce flammable release hazards at LNG facilities. FS-World Magazine "Oil & Gas Industry" edition, Spring 2014.

Kytömaa HK, Morrison DR. A moving target. LNG Industry Magazine, November/December 2013; 57-62.

Kytömaa HK, Morrison DR. The Liquefied Natural Gas (LNG) industry and fire protection regulations. Fire Protection Engineering 2013; 60: 8-24.

Ogle RA, Morrison DR, Dee SJ. Using assessments to improve process safety culture. Process Safety Progress 2014; 33(2):148-151.

Morrison DR, Fecke M, Ramirez JC. Using LOPA to understand necessary safeguards for steam boiler operation. Process Safety Progress 2012; 31(3): 248-254.

Morrison DR, Hart RJ. Guidelines for identifying and mitigating thermal hazards of sustainable materials. Process Safety Progress 2012; 31(2):174-181.

Morrison DR, Fecke M, Martens, JD. Migrating an incident reporting system to a CCPS process safety metrics model. Journal of Loss Prevention in the Process Industries 2011; 24:819-826.

Ponchaut NF, Kytömaa HK, Morrison DR, Chernovsky MK. Modeling the vapor source term associated with the spill of LNG into a sump or impoundment area. Journal of Loss Prevention in the Process Industries 2011; 24(6): 870-878.

Fecke M, Martens JD, Cowells J, Morrison DR. A guide to developing and implementing safety checklists: Plant steam utilities. Process Safety Progress 2011; 30(3):240-250.

Ogle RA, Morrison DR. Burn injury caused by mixing incompatible chemicals with sodium permanganate. Process Safety Progress 2011; 30(2):148-153.

Ogle RA, Morrison DR. Hazards of unplanned power outages: Implementing appropriate safeguards. Process Safety Progress 2011; 30(2):99-103.

Ramirez JC, Ogle RA, Carpenter AR, Morrison DR. Preventing overpressure hazards from trapped liquids. Process Safety Progress 2010; 29(4): 313-317.

Morrison DR. Fire containment and clothes dryers. Appliance Magazine 2009 Nov/Dec; 66(9):16-19.

Su YS, Morrison DR, Ogle RA. Chemical kinetics of calcium hypochlorite decomposition in aqueous solutions. Journal of Chemical Health and Safety 2009 May/Jun; 16(3):21-25.

Morrison DR, Ogle RA. Further application of the Semenov model to evaluate the possibility of spontaneous combustion in tumble dryers. Journal of Fire Science 2008; 26(2):173-190.

Ogle RA, Morrison DR, Carpenter AR. The relationship between automation complexity and operator error. Journal of Hazard Materials 2006; 159(1-3):135-141.

Morrison DR, Su YS, Fecke MJ. Spontaneous combustion tendency of household chemicals and clothes dryers - Part 2. Appliance Magazine 2006 Jul; 6:26-30.

Morrison DR, Su YS, Fecke MJ. Spontaneous combustion tendency of household chemicals and clothes dryers - Part 1. Appliance Magazine 2006 Jun; 7:26-31.

Ogle RA, Morrison DR, Carpenter AR, Su YS. Missed opportunities in reactive chemical hazard evaluations. Process Safety Progress 2006 Mar; 25(1):2-7.

Morrison DR, Ogle RA, Viz MJ, Carpenter AR, Su YS. Investigating chemical process accidents: Examples of good practices. Process Safety Progress 2006 Mar; 25(1).

Ogle RA, Morrison DR, Viz MJ. Emergency response to a noncollision hazmat release from a railcar. Process Safety Progress 2005 Jun; 24(2):81-85.

Ogle RA, Carpenter AR, Morrison DR. Lessons learned from fire and explosions involving air pollution control systems. Process Safety Progress 2005 Jun; 24(2):120-125.

Ogle RA, Carpenter AR, Morrison DR. Explosion of a railcar containing toluene diisocyanate waste. Process Safety Progress 2004 Dec; 23(4):316-320.

Ogle RA, Megerle MV, Morrison DR, Carpenter AR. Explosion caused by flashing liquid in a process vessel. J Hazard Mat 2004; 115(1-3):133-140.

Morrison DR, Carpenter AR, and Ogle RA. Common causes and corrections for explosions and fires in improperly inerted vessels. Process Safety Progress 2002 Jun; 21(2):142-150.

Ogle RA, Morrison DR. Investigation of an acid spill caused by the failure of an air-operated diaphragm pump. Process Safety Progress 2001 Mar; 20(1):41-49.

Conference Proceedings and Invited Presentations

Reding N, Rivera-Castro G, Hart RJ, Morrison DR. Chemical Loading and Unloading: Risks at the Intersection of the Truck Driver and the Facility, AIChE Southwest Process Technology Conference. September 2025.

Lardinois TM, Schroeder E, Morrison T. Hazards and Fundamentals of Handling and Transferring Flammable, Caustic, and Toxic Liquid Chemicals in Non-Steady-State Operations, AIChE Midwest Regional Conference. April 2025.

Mott E, Morrison DR. Oh No! The Worst Has Happened – Leveraging Privilege in Incident Investigations, 2025 Spring National Meeting and 21st Global Congress on Process Safety, Dallas, Texas, April 8, 2025

Reding N, Mastalski I, Morrison DR. Oleum Release – When the Hose Breaks. Presentation at American Institute of Chemical Engineers, 2025 Spring National Meeting and 21st Global Congress on Process Safety, Dallas, Texas, April 8, 2025.

Schroeder E, Lardinois TM, Morrison DR. Steam Explosion: Process Safety in Molten Metal Processes, Poster, AIChE Global Congress on Process Safety, Dallas, Texas, April 2025.

Morrison DR. Hazards at the Periphery of Risk Based Process Safety. Presentation at the Center for Chemical Process Safety Fall Technical Steering Committee Meeting, Houston, Texas, November 13, 2024.

Lardinois TM, Swann J, Morrison T. Investigating Spontaneous Combustion and Fire Protection Engineering at an Insulating Panel Manufacturing Facility, International Symposium On Fire Investigation Science & Technology. September 2024, pp. 331-340.

Morrison DR, Cox BL, Schneider J. Understanding Deflagration and Detonation Arresters. 10th CCPS Latin American Conference on Process Safety, Barranquilla, Colombia, September 18, 2024.

Morrison DR, Cox BL, Mastalski I. Explosion of a Cooling Tower Dosing System. 10th CCPS Latin American Conference on Process Safety, Barranquilla, Colombia, September 18, 2024.

Cox BL, Schulman NS, Morrison DR. Blue Skies, Green Risk Matrices – Managing the Hazards Associated with Air Pollution Control Equipment. American Institute of Chemical Engineers, 2024 Spring National Meeting, 13th Process Safety Management Mentoring, New Orleans, LA, March 24-28, 2024.

Morrison DR. Keynote Presentation: Process Safety – Learning from Disaster, 11th World Congress of Chemical Engineering, Process Safety International Symposium, Buenos Aires, Argentina, June 4-8, 2023.

Reding N, Ibarreta AF, Wechsung A, Hart RJ, Morrison DR. Blended Natural Gas/Hydrogen Fuel Gas Systems: An Evaluation of Risk. American Institute of Chemical Engineers, 2023 Spring National Meeting and 19th Global Congress on Process Safety, Houston, TX, March 12-16, 2023. Further, presented at 10th CCPS Latin American Conference on Process Safety, Barranquilla, Colombia, September 19, 2024.

Walters MS, Cox BL, Dee SJ, Morrison DR. Is My Liquid Trapped? 19th Global Congress on Process Safety, Houston, Texas, March 12-16, 2023.

Morrison DR, Fávero CVB. Pre-conference Workshop. Fundamentals of Accidental Fires and Explosions. 9th CCPS Latin American Conference on Process Safety, Rio de Janeiro, Brazil, October 18-20, 2022.

Morrison DR, Revez D, Lardinois T, Peron G. An Unexpected Explosion While Fumigating a Grain Silo – It Wasn't the Dust, Presentation at 9th CCPS Latin American Conference on Process Safety, Rio de Janeiro, Brazil, October 18-20, 2022.

Morrison DR, Cox B, Walters M. Investigating Chemical Process Incidents & Near Misses, Short Course. 18th Global Congress on Process Safety, San Antonio, Texas, April 10, 2022.

Ibarreta AF, , Hart RJ, Colella F, Morrison DR. Análisis y Mitigación De Fugas De Material Inflamable En Terminales De Gas Natural Licuado. 18 Global Congress on Process Safety, San Antonio, Texas, April 10-14, 2022.

Morris JM, Yen M, Ibarreta AF, Morrison DR, Hart RJ. Vapor Cloud Explosions in Complex Geometries – Application of the BST Method. 18 Global Congress on Process Safety, San Antonio, Texas, April 10-14, 2022.

Morrison DR, Hart RJ. Risk Analysis in LNG by Rail. Presentation to Committee for the Safe Transportation of Liquefied Natural Gas by Railroad Tank Car – Phase 2, National Academies of Sciences, Engineering, Medicine, Transportation Research Board, November 9, 2021.

Stern MC, Fávero CVB, Ibarreta AF, Colella F, Morrison DR, Myers TJ. Flame Arrestor Failures in Industrial Equipment and Consumer Products. 17th Global Congress on Process Safety, Virtual Conference, April 18 - 22, 2021.

Morrison DR, Hart RJ, Morris JM, Wikramanayake ED, Song S. Minimizing Risk of Unit Trains of Hazmat. 17th Global Congress on Process Safety, Virtual Conference, April 18 - 22, 2021.

Morris JM, Zanganeh N, Hart RJ, Morrison DR. What Is the Safest Hazard Assessment Approach for Distances to Storage Tanks? 17th Global Congress on Process Safety, Virtual Conference, April 18 - 22, 2021.

Kas K, Morrison DR. It Was a Dark and Stormy Night – Investigation of Acrylate Storage Tank Explosions. 17th Global Congress on Process Safety, Virtual Conference, April 18 - 22, 2021.

Morris JM, Morrison DR, Hart RJ., Why Storage Tanks Leak and How to Stay Safe? 2021 AIChE Midwest Regional Conference, Chicago, IL.

Morris JM, Hart RJ, Morrison DR. Vapor Dispersion: How Safe Is Your Safety Factor? 20th Topical Conference on Gas Utilization, Virtual Conference, August 2020.

Coelho, C.J., Lakhiani, S.D., & Morrison, D. (2019). Staying Alert: Incorporating Human Fatigue in Risk Management. Proceedings of the International Annual Meeting of the Human Factors and Ergonomics Society, October 28-November 1, 2019.

Morrison DR, Downs D. Modernizing Process Safety Management in Pulp & Paper. Presentation at 76th Annual Pulp & Paper Safety Association Safety and Health Conference, San Antonio, Texas, June 24, 2019.

Coelho CJ, Cullen P, Lakhiani SD, Morrison DR. Staying Alert: Incorporating Fatigue in Risk Management. 15th Global Congress on Process Safety, New Orleans, Louisiana, March 31 - April 3,

2019.

Hart RJ, Morris JM, Morrison DR. Sensitivity Analysis of Transport Conditions on Liquefied Gas Hazards. 15th Global Congress on Process Safety, New Orleans, Louisiana, March 31 - April 3, 2019.

Traina N, Morrison DR. Applying toxic gas exposure models for fire victim exposure. International Symposium on Fire Investigation, Itasca, IL, September 24-26, 2018.

Dillon SE, Goodman A, Morrison DR, Hill SE. Burning down the house: real world fire science. Fire Science and Litigation Seminar, Defense Research Institute, Washington, D.C., September 13-14, 2018.

Osorio-Amado C, Getsinger D, Morrison DR. The role of management of change in incident root cause analysis, 8th Latin Conference on Process Safety, Buenos Aires, Argentina, September 10-13, 2018.

Morrison DR, Hart RJ, Reed M, Peterson E. Hot work safety zones - What if there is a leak? 14th Global Congress on Process Safety, Orlando, Florida, April 22-25, 2018.

Hart RJ, Garcia ME, Morrison DR. What is the safest way to move LNG? 14th Global Congress on Process Safety, Orlando, Florida, April 22-25, 2018.

Morrison DR, Cox B. Investigating Chemical Process Incidents & Near Misses, Short Course. 13th Global Congress on Process Safety, Orlando, Florida, April 22-25, 2018.

Ibarreta AF, Hart RJ, Morrison DR, Kytömaa HK. LNG Facilities- Changing Regulations. NFPA Conference and Expo, Boston, Massachusetts, 2017.

Morrison DR, Aiken C, Lakhiani SD, van der Graaf P. A Case Study in Human Reliability - Analysis to Support LOPA in Unloading Hazardous Liquids. 13th Global Congress on Process Safety, San Antonio, Texas, March 26-29, 2017.

Hart RJ, Morrison DR. Understanding Tolerable Risk Criteria - Considering the Growth of LNG Transportation. 13th Global Congress on Process Safety, San Antonio, Texas, March 26-29, 2017.

Morrison DR, Stern M, Osorio-Amado CH. Waste Solvents to Trash Haulers: Lessons Learned from Hazardous Waste Accidents. 13th Global Congress on Process Safety, San Antonio, Texas, March 26-29, 2017.

Morrison DR. Process Safety Management in Small- and Mid-Scale Liquefaction. GasPro Americas, Houston, Texas, September 13-14, 2016.

Morrison DR, Fecke MT. Presentation on Management of Change and Major Incident Investigation. Cargill Sponsored CCPS University Faculty Workshop in Blair, Nebraska, August 18, 2016.

Morrison DR, Dee SJ. Presentation on Major Incident Investigation and Dust Explosion Hazards. Archer Daniels Midland Sponsored CCPS University Faculty Workshop in Decatur, Illinois, July 28, 2016.

Morrison DR, Cox B. Investigating Chemical Process Incidents & Near Misses, Short Course. 12th Global Congress on Process Safety, Houston, Texas, April 10, 2016.

Dee SJ, Ogle RA, Morrison DR, Fecke MT. Becoming "Wiser" in Management of Change. 12th Global Congress on Process Safety, Houston, Texas, April 11-13, 2016.

Lakhiani SD, Morrison DR. Bridging Process and Occupational Safety Cultures for the Process Safety Professionals. 12th Global Congress on Process Safety, Houston, Texas, April 11-13, 2016.

Lakhiani SD, Morrison DR. Human Factors Considerations in 3D Model Reviews. Presentation at 12th

Global Congress on Process Safety, Houston, Texas, April 11-13, 2016.

Lakhiani SD, Morrison DR. Sala JB. Addressing the Gaps between Occupational and Process Safety Cultures. Session 14P - Behavioral Safety, SPE International Conference, Stavager, Norway, April 2016.

Morrison DR, Anderson DM, Smyth SA, Hetrick TH. Understanding the fire risks of eCigarettes, Vapes, and Mods. DRI Product Liability Conference, New Orleans, LA, February 3-5, 2016.

Morrison DR. Learning from engineering disasters. Petrochemical Operations, Maintenance & Safety - Conference & Exhibition, Houston, TX, November 18-19, 2015.

Morrison DR, Hart RJ. Fire science and investigation. Invited lecture to BME 4093 - Special Topics: Forensic Engineering, Lawrence Technological University, Detroit, MI, November 11, 2015.

Morrison DR. Identifying and managing the risks of LNG in rail. 3rd Annual Natural Gas for Off-Road Applications USA 2015, Houston, TX, June 2-3, 2015.

Morrison DR. Fire science and investigation. Invited lecture, Knox College, Chem 161, Introduction to Forensic Science. 2012, 2015.

Smyth S, Morrison D, and Cox B. Application of HBSE to the fire risk of clothes dryers. Proceedings, 2015 IEEE Symposium on Product Compliance Engineering, Product Safety Engineering Society, May 2015.

Hart RJ, Morrison DR. The hazard we know: Comparing transportation risk of LPG and LNG. American Institute of Chemical Engineers, 2015 Spring National Meeting and 11th Global Congress on Process Safety, Austin, TX, April 26-30, 2015.

Morrison DR, Kumar V, Dee SJ, Cox BL, Al-Shamary M, Al-Qabandi A. Fire from the cascading failure of an oxygen supply system. American Institute of Chemical Engineers, 2015 Spring National Meeting and 11th Global Congress on Process Safety, Austin, TX, April 26-30, 2015.

Lakhiani S, Khan F, Morrison DR. Guidelines for creating a process safety culture assessment tool. American Institute of Chemical Engineers, 2015 Spring National Meeting and 11th Global Congress on Process Safety, Austin, TX, April 26-30, 2015.

Morrison DR. Fire science and investigation. Invited lecture to AA252: Techniques of Failure Analysis, Stanford University, April 10, 2015.

Ramirez JC, Morrison DR, Hart RJ, Hetrick TM. Atmospheric venting of flammable gas to a "safe area": comparing guidelines to calculations. SPE-15HSSE-P-305-SPE-MS. SPE E&P Health, Safety, Security, & Environmental Conference - Americas, Denver, CO, March 16-18, 2015.

Dee SJ, Cox BL, Hart RJ, Farina R, Morrison DR. Effects of cooking on the thermal ignition behavior of vegetable oil. Proceedings, 2015 Fire and Materials Conference, San Francisco, CA, Interscience Communications Limited, London, pp. 889-904, February 2015.

Morrison DR. Safety risk evaluations of FLNG projects. The Second FLNG & FPSO Design & Technology Conference, Dongpu, Guangzhou, China, January 13-14, 2015.

Morrison DR. LNG risk management. LNG Bunkering North America, A technical guide to overcoming the safety, design and operational challenges of LNG bunkering, Lloyd's Maritime Academy, Miami, FL, October 29-30, 2014.

Hetrick TM, Morrison DR, Ramirez JC, Ott BA, Karnesky J. Analysis of flammable liquid ejection from a container following headspace vapor ignition. International Symposium on Fire Investigation, Hyattsville, MD, September 22-24, 2014.

Khan FS, Morrison DR. The relationship between religiosity and safety culture in the process industry. 6th CCPS Latin American Conference on Process Safety, Buenos Aires, Argentina, September 15-17, 2014.

Hart RJ, Morrison DR. Rail transportation risk assessment comparison: Ethanol versus LNG. 6th CCPS Latin American Conference on Process Safety, Buenos Aires, Argentina, September 15-17, 2014.

Morrison DR, Ramirez JC, Smyth S, Fecke MT. Understanding and managing the often-ignored fire & explosion hazards of industrial air systems. 6th CCPS Latin American Conference on Process Safety, Buenos Aires, Argentina, September 15-17, 2014.

Morrison DR. FLNG Risk Management. Post-Conference Workshop at the 8th Annual FLNG Conference, Seoul, Korea, August 28, 2014.

Morrison DR. Pick a Pillar - The role of incident investigation in process safety. Invited presentation to the Chicago Section of the American Institute of Chemical Engineers, Chicago, IL, April 9, 2014.

Ramirez JC, Morrison DR, Hart RJ, Hetrick TM. Venting flammable gas to a "safe area": An objective review of best practices and guidelines. American Institute of Chemical Engineers, 2014 Spring National Meeting, 48th Annual Loss Prevention Symposium, New Orleans, LA, March 30-April 2, 2014.

Morrison DR, Hart RJ. Utilising risk assessment for safe LNG bunker operations. LNG Bunkering North America, A technical guide to overcoming the safety, design and operational challenges of LNG bunkering, Lloyd's Maritime Academy, Miami, FL, November 18-19, 2013.

Hetrick T, Ramirez JC, and Morrison D. Ejection of flammable liquids during loading and unloading: A preliminary experimental investigation. ASME 2013 International Mechanical Engineering Conference & Exposition (IMECE 2013), San Diego, CA, November, 2013.

Ibarreta A, Hart RJ, Ponchaut NF, Morrison D, Kytömaa HK. How does concrete affect evaporation of cryogenic liquids: evaluating LNG plant safety. ASME 2013 International Mechanical Engineering Congress & Exposition (IMECE 2013), San Diego, CA, November, 2013.

Morrison DR, Smyth S. Fire science and investigation. Invited lecture to BME 4093 - Special Topics: Forensic Engineering, Lawrence Technological University, Detroit, MI, November 6, 2013.

Morrison DR, Kytömaa HK. Evaluating risk management and reliability for safe, continuous and efficient LNG operations. Workshop at the 8th Annual LNG Tech Global Summit, Barcelona, Spain, October 14-16, 2013.

Morrison DR, Fecke, M. Evaluating self-heating and ignition hazards in combustible dust handling equipment. 5th CCPS Latin American Process Safety Conference and Expo, Cartagena, Columbia, August 12-14, 2013.

Morrison DR, Marr KC. Guidelines for applying process hazard analysis techniques to combustible dust applications. 5th CCPS Latin American Process Safety Conference and Expo, Cartagena, Columbia, August 12-14, 2013.

Cox BL, Dee SJ, Hart RJ, Morrison DR. Development of a steel component combustion model for fires involving pure oxygen systems. American Institute of Chemical Engineers, 2013 Spring National Meeting, 47th Annual Loss Prevention Symposium, San Antonio, TX, April 28-May 2, 2013.

Ogle RA, Morrison DR, Dee SJ. Using assessments to improve process safety culture. American Institute of Chemical Engineers, 2013 Spring National Meeting, 28th Center for Chemical Process Safety International Conference, San Antonio, TX, April 28-May 2, 2013.

Ibarreta AF, Hart RJ, Morrison DR, Kytömaa HK. A View of the evolving LNG regulations and associated exclusion zones from an industry perspective. American Institute of Chemical Engineers 2013 Spring National Meeting, 13th Topical Conference on Gas Utilization, San Antonio, TX, April 28-May 2, 2013.

McInerney E, Hart R, Morrison DR, Kytömaa H. New quantitative risk criteria for U.S. LNG facilities. American Institute of Chemical Engineers 2013 Spring National Meeting, 47th Loss Prevention Symposium, San Antonio, TX, April 28-May 2, 2013.

Hart RJ, Morrison DR, Ibarreta AF, Kytömaa HK. Guidelines for relative hazard ranking of refrigerants and siting considerations for LNG liquefaction units. American Institute of Chemical Engineers 2013 Spring National Meeting, 13th Topical Conference on Gas Utilization, San Antonio, TX, April 28-May 2, 2013.

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Morrison DR, Ogle RA. Evaluating kinetic parameters for solid substances exhibiting complex self-heating behavior. American Institute of Chemical Engineers, 2008 Spring National Meeting, 42nd Annual Loss Prevention Symposium, New Orleans, LA, April 7-9, 2008.

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Morrison DR, Ogle RA, Gidaspow D. A new assessment of the finite Biot number correction to thermal ignition tests. American Institute of Chemical Engineers, 2007 Annual Meeting, Salt Lake City, UT, November 8, 2007.

Morrison DR. Transient self-heating vs. steady state theory for ignition of wood flour' and 'scientific investigation of incendiary fires.' Invited guest lectures, Knox College Chemistry Department, October 2006.

Morrison DR, Su YS, Fecke MJ. Spontaneous combustion tendency of household chemicals and clothes dryers. 2006 International Appliance Technical Conference, March 2006. This paper received the Dana Chase Memorial Award for the Best Paper presented at the conference.

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complexity. 2006 Annual Symposium, Mary Kay O'Connor Process Safety Center, Texas A&M University, College Station, TX, October 2006.

Caligiuri RD, Morrison DR. Using root cause analysis in product safety investigations. Presentation for Association of Home Appliance Manufacturers Product Liability Seminar, Washington, D.C., October 2005.

Morrison DR, Ogle RA, Viz MJ, Carpenter AR, Su YS. Investigating chemical process accidents: examples of good practices. Engineers Process Plant Safety Symposium, 2005 Spring National Meeting, American Institute of Chemical Engineers, Atlanta, GA, April 11-13, 2005.

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Morrison DR. Basic fire origin and cause investigation. Presentation and Training Program for the Illinois Association of Special Investigation Units, March 2002.

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Ogle RA, Morrison DR. Evaluation of accident investigations conducted by regulatory authorities and advisory agencies. Beyond Regulatory Compliance: Making Safety Second Nature, Mary Kay O'Connor Process Safety Center, Texas A&M University, College Station, TX, October 2000.

Project Experience

Dr. Morrison has over 25 years of experience investigating and analyzing catastrophic incidents domestically and internationally including fires, explosions, and hazardous releases. He leverages that expertise to assist clients in identifying hazards, quantifying risks, and mitigating risks in their products, systems, and processes. He has often worked at the intersection of personal and process safety in proactive and reactive consulting services. A representative sampling of distinct practice areas and example projects is listed below.

Fire Origin and Cause Analysis

- Roof repair fire: investigated fire observed after roof repair that involved clothes dryer exhaust ducting.
- Modified rubber roofing installation: investigated fire in concealed wall cavity following propane torch heating of nearby roofing material.
- Multiple fatality fire in laundry area: analyzed hypothetical causes including laundry spontaneous combustion, dryer door latch electrical fault, and clothes iron electrical fault.
- Orchid greenhouse fire: analyzed fire spread hypotheses involving horizontal polymer shade cloth; evaluated fire dynamics based on eyewitnesses, damage patterns, and material characteristics.
- High rise kitchen fire: analyzed eyewitness observations, scene investigation, laboratory examination of electrical systems and appliance, fire dynamics calculations and modeling.
- Multiple industrial fires involving electric motors: analyzed electric motors as potential causes of fires in industrial settings.
- Cellulosic insulation fire in chimney concealed space: analyzed fire patterns, blowing activities, and hot surface ignition on fireplace insert.
- High rise office fire: investigated multiple fatality fire originating in storage room in office building, developed timeline of events, and tested fire protection systems.
- Multiple fires involving overheated bearings and rotating equipment: analyzed fire dynamics, hot surface ignition, and fire spread from potential ignition sources.

Spontaneous Combustion

- Restaurant and residential laundry fires: analyzed many fires involving laundry that may have been contaminated with vegetable- or animal-derived oils. Conducted fire cause analysis, interpretation of FAME vegetable oil residue chemical analytical results, and laboratory testing of materials.
- Industrial laundry fire: analyzed Canadian fire involving industrial laundering of uniforms, towels, and rags.
- Gymnasium floor finishing fire: investigated and analyzed contractor activities, polyurethane coating, floor finishing materials, and potential for spontaneous combustion as the cause of the fire.
- Industrial laundry fires: analyzed domestic industrial laundry fire involving rubber mats and synthetic mop heads, reconstruction of events, scaled thermal testing of mop heads, testing vegetable oil extraction in wash.
- Wood stain finishing fires: analyzed many fires potentially involving stains and coatings, analyzed and tested alternative formulations for wood stains relative to the potential for self-heating and delayed ignition.

- Polyurethane slab raising fire: analyzed self-heating and spontaneous combustion in high-density polyurethane factory floor leveling operation.
- Low temperature ignition of wood: multiple investigations and analyses of alleged low-temperature ignition of wood, also referred to as pyrophoric carbon, in residential and commercial settings.

Commercial and Consumer Products

- Commercial kitchen range: analyzed flash fire incident, claims regarding burner safety shut off valves, propane fire dynamcis, and alternative flash fire scenarios.
- Dehumidifier: evaluated short-circuit failure phenomena; developed and tested containment and mitigation methods.
- Electrostatic air cleaner: evaluated product returns, FMEA, laboratory testing and analysis to identify high voltage surface arc tracking characteristics and mitigation methods.
- Fatal CO exposure in restaurant: investigated CO leak from improper flue pipe for water heater.
- Fatal CO exposure in residential garage: investigated flue gas leak from pool heater including testing pool heater in situ and testing an idling car in enclosed garage.
- Fatal CO exposure in residence: investigated and tested flue gas recirculation from an indoor pool heater.
- Clothes dryer fires: analyzed over 100 gas and electric clothes dryers from multiple manufacturers involved in fires, failure analysis, fire spread analysis, and origin and cause analysis.
- Clothes washer design: analyzed hypochlorite salt formation from bleach, potential for surface arc tracking, and potential mitigation methods.
- Clothes dryer vent transition class action: analyzed construction, application, operation, and potential failure modes regarding class complaint.
- Clothes dryer vent termination: analyzed and tested clothes dryer vent termination devices and advised client on potential product recall.
- Clothes dryer fire containment: worked with industry organizations to develop and refine fire containment standard requirements in UL 2158.
- Clothes dryer fire containment design: worked with multiple manufacturers to analyze their current and future clothes dryer configurations, fire spread inside the appliance, and testing of fire containment design alternatives.
- Tabletop fireplace: investigated claims regarding flashback and ejection of ethanol fuel while fueling fireplace.
- Gel fuel for tabletop fireplace: analyzed and tested ignition mechanisms, flashback, and ejection of ethanol and isopropyl alcohol gel fuels.
- Smoke explosions in dryers: analyzed and tested oxygen vitiation, combustible smoke generation, and smoke explosion inside clothes dryer drums for accidental fires.
- Refrigerator fire: analyzed hypothetical fire causes related to defrost system, arc mapping, and branch circuit faulting.
- Gas-fire appliance CO exposures: investigated installation of water heaters and furnaces in townhome complex to evaluate combustion make-up air and gas migration paths into residences.

Industrial Equipment

- Boil off gas compressor: analyzed screw compressor packages used for LNG boil off gas compression to evaluate performance, potential for design defects, and potential for manufacturing defects.
- Oil flooded screw air compressor: investigated and analyzed fire involving two air compressors at a food processing plant to determine which unit failed and caused the fire.
- Oil flooded screw air compressor: investigated multiple fire incidents where the apparent cause was electrostatic discharge in the oil/air separator, loss of oil flow, and/or bypass of equipment safeguards.
- Plant air system explosion: investigated fatal explosion involving prolonged overheating of oil-flooded screw compressor, combustible smoke generation, and autoignition of vapors.
- Nitrogen separator air compressor fire: investigated fire involving air compressor used to feed nitrogen generator system, which involved bypass of equipment safeguards.
- Overheated bearing in grain elevator: analyzed grain elevator explosion allegedly caused by overheated bearing. Tested bearing overheating mechanisms, temperature monitoring, and hot surface ignition of overheated bearing grease.
- Lubricant contamination of air-powered equipment: analyzed air compressors, filtration, and plant air system design for custom woodworking facility.
- Tunnel washer performance: analyzed industrial laundry operation, tunnel washer maintenance, water chemistry, chemical treatment, and historical linen damages and rejects.
- Foam panel extrusion: analyzed electrostatic ignition events involving flammable blowing agent in fire-resistant foam board extrusion machine.
- Commercial propane filling system explosion: analyzed fatal explosion involving failure of un-rated residential propane cylinder during filling at hardware store.
- Locomotive battery failure smoke dynamics: analyzed and tested smoke transport inside and outside locomotive operator cabin related to battery fires.
- Drill machine explosions: analyzed high pressure compressor gear transfer box explosions in mobile drilling machines for shaft mining in Chile.

Reactive Chemicals, Trash and Hazardous Waste

- H2S exposure when handling liquid waste: analyzed fatal exposure after worker removed respirator while atop tanker. Included analysis of the waste generating process and resultant decomposition of the waste liquid during transport.
- Oleum exposure when transferring from rail tank car: analyzed flexible hose failure, safe work practices, and dynamics of pressure transfer of oleum.
- Waste solvent reclamation facility VCE: onsite investigation and analysis of flammable solvent release, operating data, pressure relief systems, and vapor cloud explosion.
- Solid waste incinerator shredder explosion: analyzed waste profiles, process data, and explosion dynamics related to explosion while shredding solid hazardous waste.
- Treatment, Storage, and Disposal Facility (TSDF) fire: analyzed fire event in storage area for RCRA hazardous waste, evaluated waste profiles, evaluated thermal stability of liquid waste materials.

- Cement kiln conveyor fire: analyzed shredded waste fuel storage and handling, waste profiles, analytical characterization methods, and alternative ignition methods including hot surface ignition and spontaneous combustion. Developed safe storage and handling guidelines.
- TSDF fire: analyzed thermal runaway involving chemical oxygen generators, solid oxidizers, and incompatible waste materials.
- Municipal waste transfer station fire: analyzed potential for combustor tram (hydrated calcium oxide / lime) to self-heat and cause fire, investigated alternative causes of fire.
- TSDF fire: analyzed waste profiles, handling, and ignition of strong oxidizer liquid red fuming nitric acid.
- Cooling water treatment system explosion: investigated and analyzed mixing of incompatible biocide chemicals in brominator system for machinery cooling water circuit.
- Sodium percarbonate decomposition: investigated and analyzed new manufacturing process, thermal stability of solid peroxide formulations, and laboratory testing of thermal runaway decomposition.

Workplace Safety Incidents and Safe Work Practices

- Human reliability analysis of loading operations and procedures: developed HRA model and coached multiple clients on application to tank car loading operations for a toxic chemical.
- Lubricating oil tanker explosion: investigated a switch loading explosion where a tanker switched from gasoline load to a high flashpoint oil causing an electrostatic discharge during splash loading.
- Diesel fuel tanker explosion: investigated a switch loading explosion where flammable headspace was ignited by electrostatic discharge during overhead filling operation.
- Hot work explosion in fermentation tank: analyzed control of work, ethanol vapor liberation, purging activities, and cutting activities that caused explosion.
- Fatal methyl mercaptan release: analyzed PSM program, documentation, and safe work practices including line break, LOTO, and operator responsibilities for covered and non-covered processes.
- Demolition management system root cause analysis: facilitated root cause analysis of procedures and practices involved in industrial demolition incident.
- Derailment remediation hot work flash fire: analyzed control of work for cutting activity, pressurized flashing liquefied butadiene release, flammable vapor detection limits, and fire dynamics.
- Hexane flash fire: investigated hexane release modes, control of work, and accidental ignition of hexane vapor released from a pump exhaust in an Indian vegetable oil extraction plant.
- Arc flash explosion during demolition: analyzed control of work, LOTO, and cutting activities during demolition of high voltage distribution system at industrial facility.
- Water engulfment when entering scrubber: analyzed control of work, LOTO, confined space entry for incident involving blast furnace scrubber system.
- Flash fire in desulphurization vessel: analyzed hot work safety practices, H2S liberation from iron pyrite absorbent, and flash fire during hot work on isolated vessel.
- Tank tie-in risk assessment: led structured analysis of alternative methods of isolation of active LNG systems including use of Carber plugs, purging, and monitoring for safe hot work.

- Human reliability analysis of loading operations: developed HRA model approach for propylene oxide unloading and ethanol loading/unloading operations.
- Procedures review for LNG facility: evaluated operating procedures for greenfield small scale LNG liquefaction facility.
- Pre-Startup Safety Review: developed and implemented PSSR for greenfield small scale LNG liquefaction facility.

OSHA Process Safety Management (PSM)

- Propane cylinder filling facility: led process hazard analyses for residential propane cylinder filling facilities to aid owner in implementing PSM systems.
- Propane cylinder filling facility citations: analyzed regulatory requirements, OSHA PSM, and safe work practices following cylinder storage area maintenance and fire.
- OSHA PSM-covered boundaries: analyzed a series of legacy process units and facilitated hazard analysis to assist client in defining coverage boundaries for multiple domestic paper mill facilities.
- OSHA PSM elements: multiple projects aiding clients in specific aspects of OSHA PSM including covered process boundaries, PHA compliance, process safety information, pre-startup safety review, mechanical integrity, and management of change (MOC).

Hazard Identification and Risk Analysis

- Transportation risk analysis: quantitative risk analysis, route analysis, truck transportation of flammable hazardous materials.
- US LNG regulatory permitting support: hazard analysis for flammable vapor dispersion, jet fire, vapor cloud explosion, and pool fire analysis for multiple domestic export facilities.
- Mexico LNG regulatory permitting support: quantitative risk analysis and environmental risk analysis for flammable vapor dispersion, jet fire, vapor cloud explosion, and pool fire analysis for liquefaction projects at export facility.
- Natural gas dual fuel locomotive: hazard analysis, transportation risk analysis, and FRA regulatory support for LNG fuel tender project for Class II railroad.
- LNG by rail: hazard analysis, transportation risk analysis, and FRA regulatory support for shipping LNG in T75 ISO containers by rail.
- LNG by rail: transportation risk analysis and FRA and PHMSA regulatory support for shipping LNG in DOT113 tank cars by manifest and unit train configurations.
- CNG by rail: hazard and consequence analysis of novel CNG tank car transport, filling, and unloading.
- Mexico marine hydrocarbon fuels permitting support: quantitative risk analysis for onshore hydrocarbon fuels terminal including ship-to-shore transfer.
- Hydrocarbon fuel terminals: led multiple process hazard analyses with LOPA at domestic fuel terminals involving onsite transfer, pumping, truck loading racks, and atmospheric storage tanks for gasoline, diesel, jet fuel, and ethanol.
- Hydrocarbon pipelines: led multiple process hazard analyses with LOPA for domestic cross-country pipelines, pump stations, and compressor stations for crude oil, gasoline, diesel, jet fuel, natural gas liquids, propane, and butane.

- Marine hydrocarbon fuel terminals: led multiple led multiple process hazard analyses with LOPA at domestic terminals involving ship-to-shore transfer, ship loading arms, pumping, and atmospheric storage tanks for crude oil and hydrocarbon fuels.
- Coal handling hazard analysis: led multiple coal and combustible dust handling PHAs with LOPA for power and process boiler systems.
- Vapor collection unit: led multiple hazard analyses with LOPA for flammable vapor collection units including operator actions, vapor hoses and transport, activated carbon systems, and regeneration.
- Groundwater remediation system: led hazard analyses with LOPA to assist in design choices for remediation system standard design options for multiple domestic brownfield sites.

Dryers, Ovens, Furnaces, and Thermal Oxidizers

- Animal feed dryer explosion in Chile: analyzed fuel gas train, flue gas circulation, controls, and explosion dynamics to determine cause of explosion.
- Copper shaft furnace: facilitated a safety system review against best practices in NFPA 86 Standard for Ovens and Furnaces.
- Continuous dryer laminator: tested and analyzed multi-zone dryer for applying solvent-based adhesive coating on a polymer release liner in pharmaceutical process, with web handling and continuous curing.
- Continuous film dryer: analyzed infrared film dryer for applying adhesive coating on a polymer films, safe operating parameters, and fire code compliance.
- Gas-fired boiler safety analysis: evaluated process design, safeguards, and operating hazards.
- Spray dryer safety analysis: evaluated process design, safeguards, and operating hazards.
- Flash dryer safety analysis: evaluated process design, safeguards, and operating hazards.
- Carbon furnace safety analysis: evaluated process design, safeguards, and operating hazards.
- Thermal oxidizer safety analysis: evaluated process design, safeguards, and operating hazards.
- Product hopper flash fire: analyzed bridging of recycled newspaper pulp in steam tube dryer’s product hopper, hot surface ignition, spontaneous ignition, maintenance activities, engulfment, and flash fire causing personnel burn injuries.
- Animal feed dryer CO explosion: analyzed feed handling and recycling systems, burner combustion controls, shutdown, material accumulation, self-heating, and off-gas recirculation in indirect heat dryer system.
- Gluten flash dryer explosion: analyzed operating parameters, controls, and combustion safety systems related to accumulation, overheating, and ignition in ring dryer system.
- Peanut roasting oven fire: analyzed operations, controls, safety systems, and material handling systems including product bucket elevator conveyor and screw conveyors.
- Cocoa bean roasting oven explosion: analyzed operations, controls, safety systems, and potential ignition mechanisms in multi-zone roasting oven.
- Heat treating furnace explosion: analyzed Class C endothermic atmosphere furnace operation, PLC control upgrade project, and safety controls to determine cause of explosion inside oven.
- Roll curing oven explosion: analyzed combustion safety systems, industrial rollers, and explosion due to trapped liquid inside roller.

Food, Chemical, and Energy Industry Incidents and Process Design

- Cryogenic air separation unit rectifier column: analyzed poor performance of high and low pressure distillation columns and the relationship to installation of column internals including structured packing.
- Ethylene oxide process explosion: analyzed an EO manufacturing process, plausible release scenarios, and decomposition, deflagration, and detonation phenomena.
- Ammonia and urea fertilizer production: analyzed defect claims associated with the design, construction, and operation of a grass roots facility to produce ammonia via methane steam reforming then catalyst converter synthesis.
- Refinery upset, fire, and explosion: analyzed crude tower operation, crude upsets, process stability, operator actions, and computer control systems.
- Chlor-alkali electrolysis plant: analyzed defect claims associated with demister technology, capacity analysis, process design and construction delays.
- Sodium bicarbonate production: analyzed defect claims associated with the design, construction, and operation of a new crystallization unit, slurry dewatering, flash dryer operation, particle separation through a cyclone and baghouse, and dilute phase conveying.
- Metallurgical smelting process plant design, operations, equipment, and hot commissioning: analyzed material handling processes, rotary drying of ores, dust collection systems, conveyor system design, plant control, smelting processes, scrubber cooling water treatment, thickener, and auxiliary equipment.
- Rubber powder production: analyzed cryogenic micronized rubber grinding operation, bulk solids handling, product powder size classification, pneumatic transport, and dust collection.
- Industrial water treatment systems: analyzed industrial raw water treatment, process water distribution, cooling water tanks, cooling towers, heat exchangers, evaporators, settlers, piping, pumps, dosing systems, and control elements including hydraulic characteristics, operating parameters, and process control.
- Hydrogen transfer fire in China: analyzed a release of hydrogen during transfer from a tube trailer to fixed facility connections including worker actions, truck and stationary valves and automated safety features.
- Switch loading explosions: analyzed multiple liquid tanker truck explosions from electrostatic spark discharge during switch loading of gasoline or ethanol and combustible liquids such as fuel oil, diesel, and lubricants.
- Hydrogen explosion while filling stationary tanks: investigated failure of rupture disk and breach of vent piping during hydrogen transfer, which caused a fatal explosion.
- Methane steam reformer: analyzed steam reformer plant failures and led root cause analysis, evaluated gaps between process specification and as-built.
- Grain elevator fumigation explosion in Mexico: analyzed fumigant application process, phosphine gas generation and accumulation, explosion dynamics, and autoignition mechanisms.
- Solvent storage facility explosion: evaluated flammable solvent storage and handling, electrostatic ignition modes.
- Brewery explosion in Puerto Rico: analyzed liquid CO2 system including manual operations, automatic operations, vaporization, and operator actions during draining that led to catastrophic explosion of surge vessels.

- Coal mill explosion: analyzed dust explosion involving coal milling unit at power plant.
- Steam boiler explosion: analyzed safety systems, burner performance, CO and partially burned fuel gas concentrations, and resulting combustion explosion dynamics.
- Flour silo explosion: analyzed dust explosion caused by electrostatic discharge due to improper bonding and grounding during pneumatic conveying of flour.
- Chloropicrin release and exposure: analyzed operator actions, procedures, safe work practices and modeled toxic vapor dispersion.
- Flammable liquid storage tanks explosion due to lightning strike: analyzed storage tank vapor venting system, tank interconnection, lightning protection, operating data, and confined deflagration dynamics in tank headspace.
- Ethylene oxide system fire: investigation and analysis of Middle East EO unit failure in oxygen system, piping and controls reconstruction, process data analysis, and maintenance practices.
- Oxygen-enhanced combustion system fire: analyzed failure of oxygen system in metallurgical furnace operation.
- Electric arc furnace steam explosion: analyzed failure of water cooling line and steam explosion dynamics in scrap metal melting furnace.
- Tocopherol reactor fires: analyzed catalyst addition process, purging design, and operating procedures to provide guidelines for safe addition and inerting.
- Malted grain silo collapse: investigated cone bottom failure in Argentina facility, analyzed process data, material characteristics, moisture drying process, and bulk solid discharge dynamics.
- Fiber conveyor system explosion: analyzed L-path, Z-path, and horizontal conveyors, dust collection systems, and dust explosion mitigation systems during explosion investigation.
- DHA feed thermal stability: analyzed self-heating and self-ignition during manufacture, storage, and handling through conveyors, FIBCs, bins, and silos for DHA product.
- Molasses tank thermal runaway: analyzed processing, chemical decomposition, and thermal stability of molasses storage following a thermal runaway in a Belize sugar refinery.
- Hydrochloric acid release on marine vessel: investigated tank failure, acid spill, and corrosive cloud formation from boiler water deionizing system on vessel in dry dock in Korea.
- Styrene railcar thermal runaway: analyzed product storage and transportation history, polymerization inhibitor depletion, and styrene thermal runaway in tank car.
- Lyophilizer silicone fluid heater explosion: analyzed process design, safety controls, PLC logic, maintenance activities and operator actions leading up to explosion and fire in cryogenic lyophilizer system.
- Flash tank explosion: investigated and analyzed alumina digestion process, power outage consequences, operator actions, reconstruction of vessel and piping systems, blow down liquid flashing dynamics, process data, and mechanical explosion mechanism.

Peer Reviews

Process Safety Progress

Journal of Loss Prevention in the Process Industries

Process Safety and Environmental Protection