

P2SAC Highlights

Ray Mentzer, Visiting Professor & P2SAC Associate Director

December 5, 2017

Attendees – Dec 5

Sponsors

- BP
- (Chevron)
- Dow
- ExxonMobil
- Honeywell
- Kenexis
- Lilly
- Phillips 66
- Shell

Guests

- Air Products
- Ashland
- Bechtel
- Cummins
- Dow AgroSciences
- Evonic
- Fauske
- ioMosaic
- NIOSH / CDC
- Pfizer

Fall P2SAC '17 Update

- P2SAC funded PhD research increased from four to six with sponsors increasing to nine and add'l dept support
- Successful completion of two process safety related Prof MS projects last summer mentored by Kenexis & Lilly
- UG research projects this fall: pharmaceutical benchmarking, analysis of pipeline failures, LNG metallurgy failures, and corrosion under insulation ... all suggested by P2SAC Sponsors
 - Spring UG project summarizing process safety regulations in several countries published in peer reviewed *Journal of Loss Prevention in the Process Industries*
- ~190 students in core Chemical Process Safety class this fall (10 graduate students)
- Engagement with other Depts this fall on process safety: AAE, ABE, IE, ME & CV
- Graduate student seminar in Sept by Prof Mannan of TX A&M; 15 faculty meetings
- Nagy group presentation at A&M MKO Safety Symposium in Oct; Mentzer at GCPS
- Assessing two potential process safety conferences at Purdue involving pharmaceutical & agriculture industries, jointly with other Depts

P2SAC **Vision** For Process Safety at Purdue

- Continue to advertise / communicate P2SAC milestones within Department, Purdue and externally on regular basis using all available communication vehicles: IAC meetings, Dept Newsletters, ..., PurdueToday, Alumni News, as well as P2SAC web-site. Encourage annual P2SAC participation at MKO Process Safety Symposium and CCPS's Global Process Safety Congress.
- To broaden faculty & graduate student understanding of process safety & encourage research in this area, invite recognized process safety experts from academia as seminar speakers – Mannan (TX A&M), Leveson (MIT), Amyotte (Dalhousie Univ), ...
- Increase P2SAC Sponsors to 15 - 20 cos, targeting a diverse group, including agriculture, pharmaceuticals, manufacturing, in addition to oil & gas and chemicals; will necessitate a diverse research program
- Continue to seek Sponsor guidance on research of interest at UG, MS and PhD levels; share results concisely & with ease of implementation in mind
- Use select research projects as a potential springboard for proposals for creation of a specialty Center(s) with significant multi-year funding from DOE, DHS, etc
- Offer Chemical Process Safety (420) to graduate students as a 597 elective to broaden graduate student understanding for those performing P2SAC funded research, as well as other interested students; encourage Professional Masters students enrollment to prepare for summer projects
- Industry recognition of Purdue ChE UG and graduate students as source of process safety expertise
- Position P2SAC as a true multi-disciplinary 'Purdue' Process Safety Center, involving faculty in other departments who are currently or have done process safety related research - AAE, ME, ...
- Add a tenure track faculty position focusing on chemical process safety over the next ~3 years; recognize difficulty in finding appropriate candidates from academia and industry



Contact Us

Events

Purdue Process Safety & Assurance Center

Each year, people around the world lose their lives due to the lack of proper training and recognition of chemical process safety. These incidents also result in injuries and environmental and facility damage. Although international recognition of the importance of chemical process safety is growing, only a few centers of expertise exist.

The Purdue Process Safety & Assurance Center (P2SAC) plays a key role in saving lives, and educating students on process safety, preparing them to address potential disasters, and equipping them for success when entering industry. Not only does P2SAC educate students on the highly technical nature of 'process' safety vs. 'personnel' safety, but it also serves as the hub for:

- Conducting cutting-edge, fundamental science-based research with experimental and theoretical modeling;
- Creating and teaching undergraduate and graduate process safety courses, and instilling Process Safety Management (PSM) awareness in core capstone design projects; and
- Providing a source of expertise for industry and other stakeholders regarding process safety-related standards and best practices.

P2SAC is uniquely focused on manufacturing and consumer products, including the oil & gas, chemical, pharmaceutical and technology industries. The research projects conducted at the center are solicited from industry sponsors, government research labs and academia.

P2SAC faculty are engaged in, and knowledgeable about various facets of process safety that enhance the educational experience of all Purdue Chemical Engineering students, and ultimately help to improve the safety of our world.

P2SAC Publications & Presentations

Overview

[P2SAC Overview \(PDF\)](#)

P2SAC 2017 Spring Conference Presentations

[P2SAC Research Program & Accomplishments - Dr. Ray Mentzer](#)

[Dust Explosion Test Methodologies - Dr. Ashok Dastidar, Fauske](#)

[Storage Tank Dike Design - Dr. George Harriott, Air Products](#)

[Key Performance Indicators for Installed SIS - Dr. Prasad Goteti, Honeywell](#)

[Robust Model-Based Control for Safe Pharmaceutical Manufacturing - Prof. Zolton Nagy](#)

[Chemistry & Catalysis of Nanoscale Materials - Prof. Raj Gounder](#)

[Latest Developments in Inherently Safer Technology - Mr. Brad Fuller, AcuTech](#)

P2SAC 2016 Fall Conference Presentations

[Safer Catalytic Oxidations - Raj Gounder \(PDF\)](#)

[Advances in Chemical Reactivity Evaluation at Dow \(PPTX\)](#)

[Overview of Core UG Chemical Process Safety Course \(PDF\)](#)

[Fault Tolerant Control for Safe Plant Operation \(PDF\)](#)

Research Publications and Presentations

Undergraduate Research

Principal Investigator: Professor Ray Mentzer

Research Publications

[Comparison of Global Process Safety Regulations](#)

Professional MS Students

[MS Computational Fluid Dynamics Study with Kenexis \(PDF\)](#)

PhD Research

CHEN 420 / 597- Chemical Process Safety – core UG course

Personnel vs. Process Safety
& Metrics

Applicable regulations: OSHA
PSM, EPA RMP, etc

Source Term Modeling

Toxicants & Industrial Hygiene

Toxic/Flammable Gas Release

Dispersion Modeling

Fire & Explosion Protection

Chemical Reactivity

Relief System Design

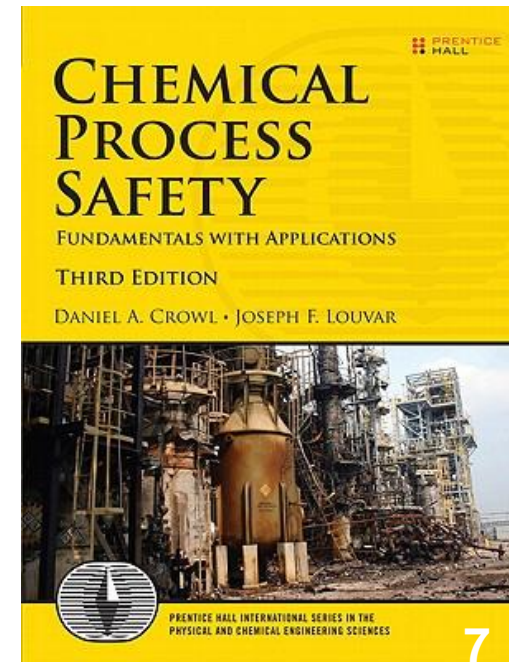
Hazards Identification (HAZOP, ..)

Risk Assessment (Matrix, QRA, ..)

Accident Investigations

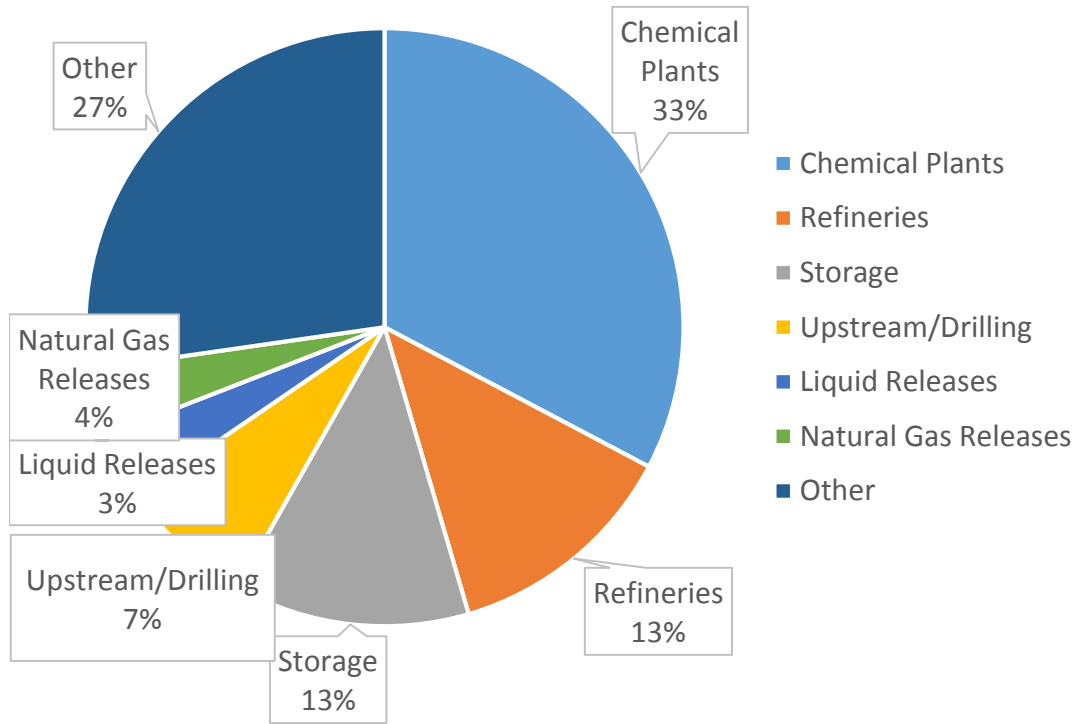


T-2 Laboratories, FL – '09; 4 fatalities

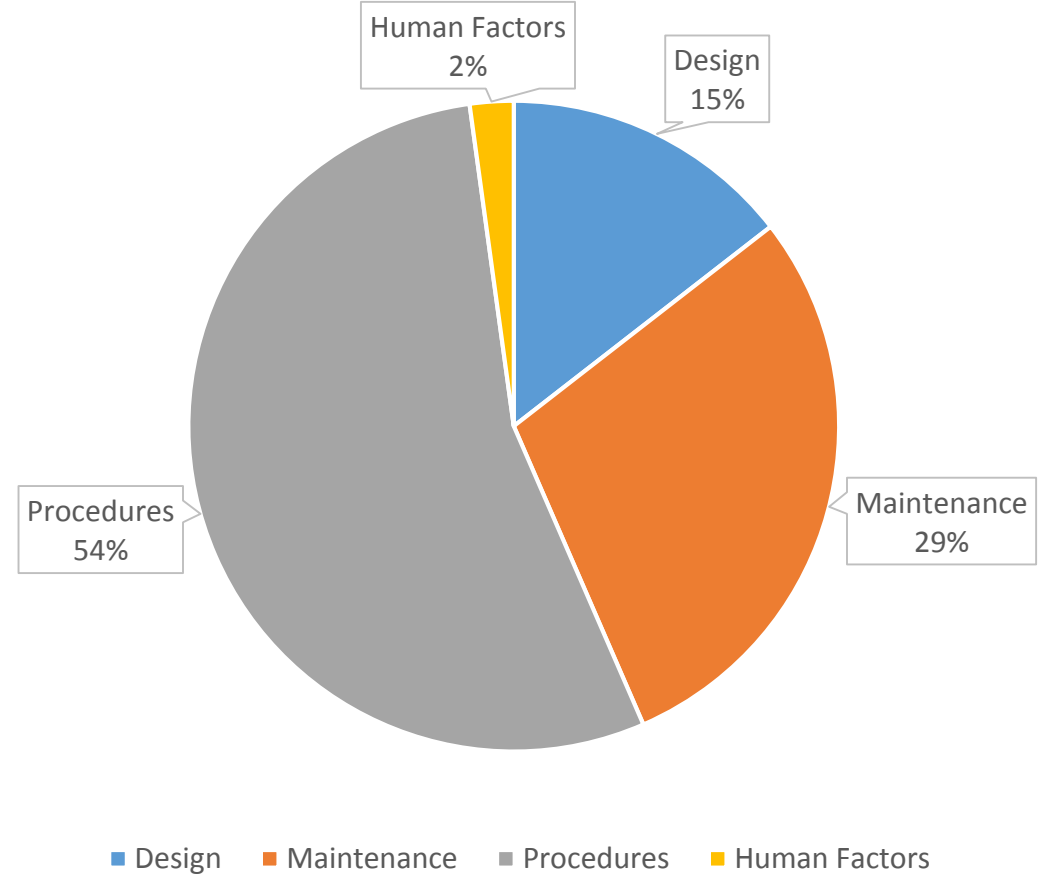


Summary of CHE 420 / 597 Incident Analyses (56 incidents)

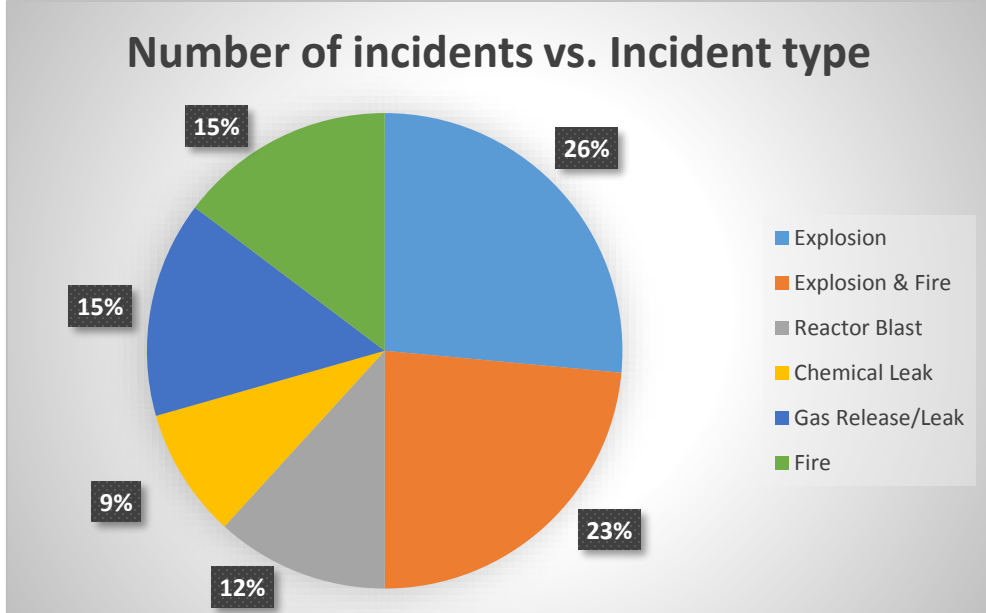
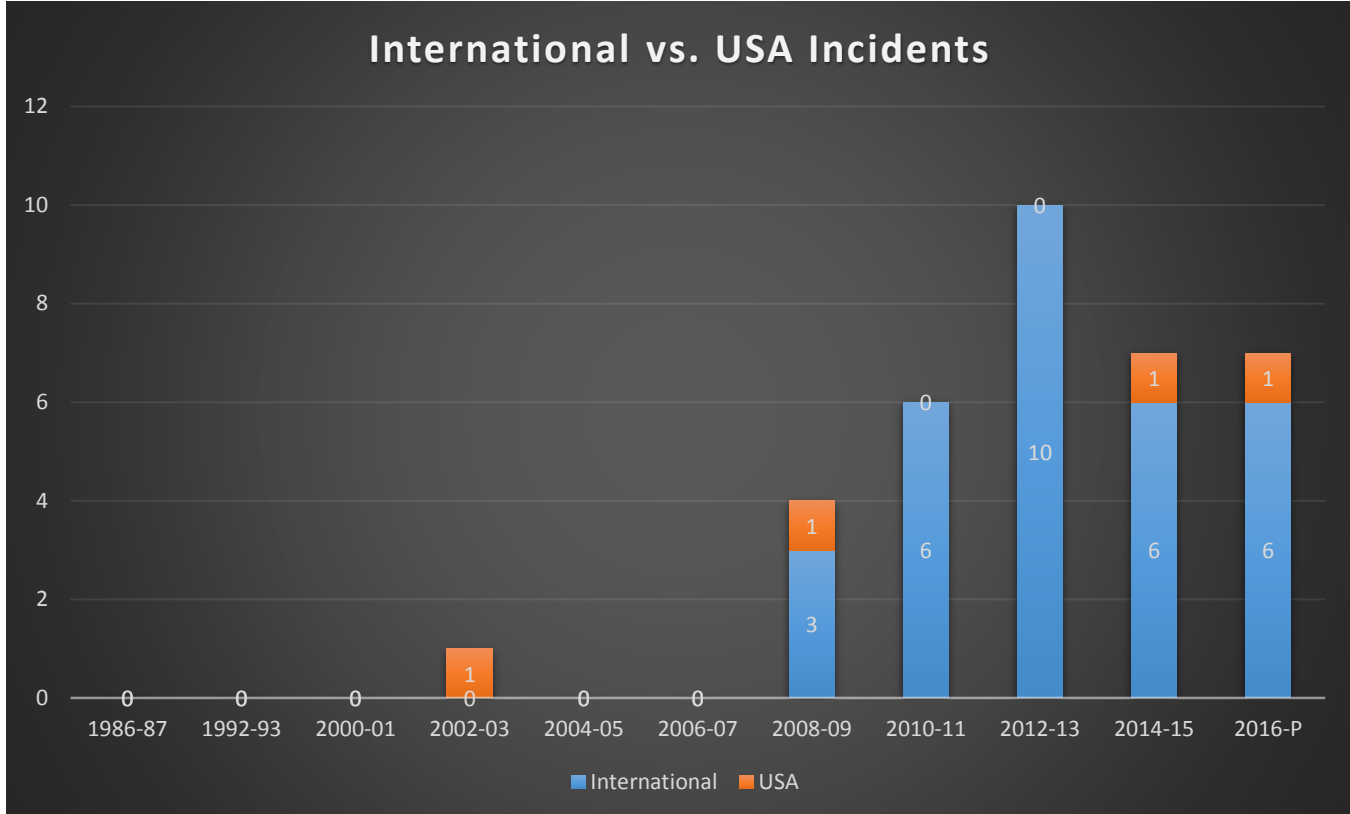
Incidents per Type of Operation



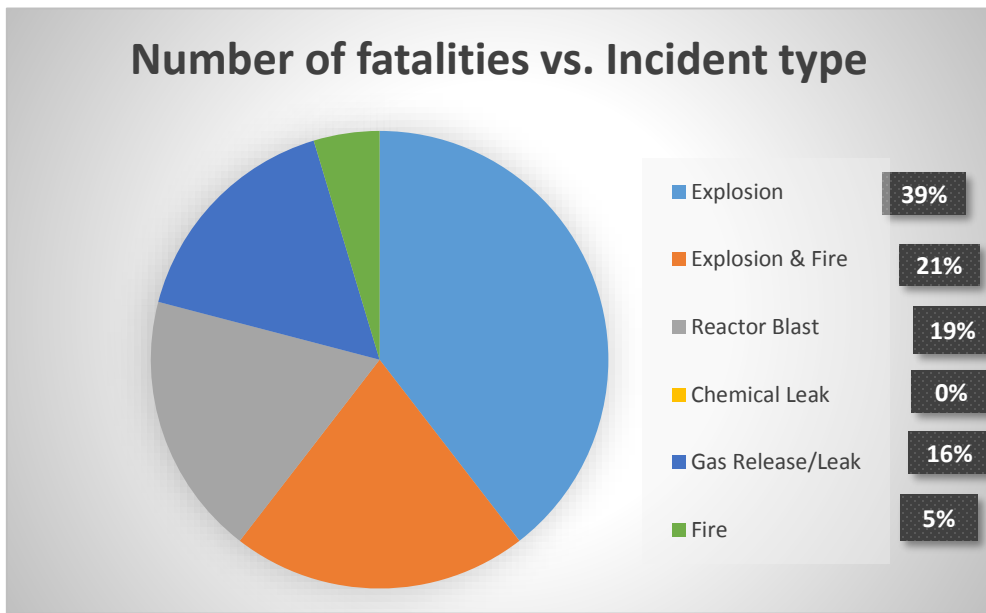
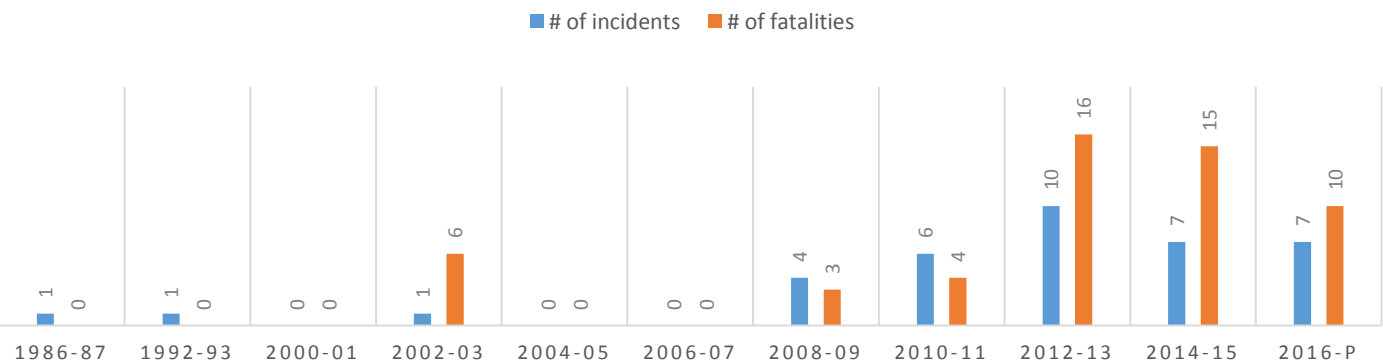
Incident Root Causes



UG Research – Process Safety Incidents in Pharmaceutical Industry (36)



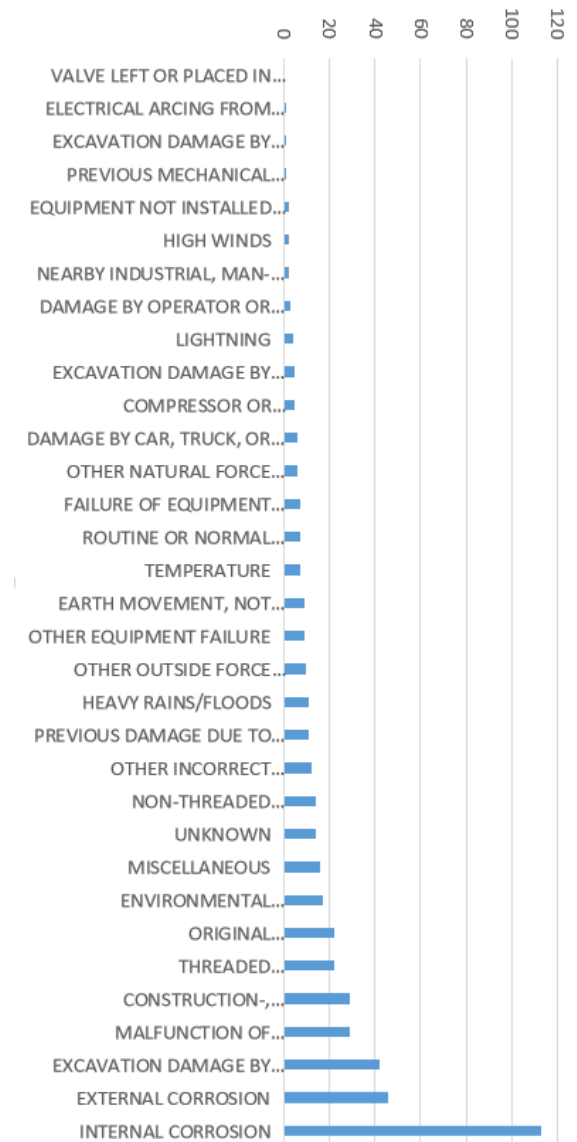
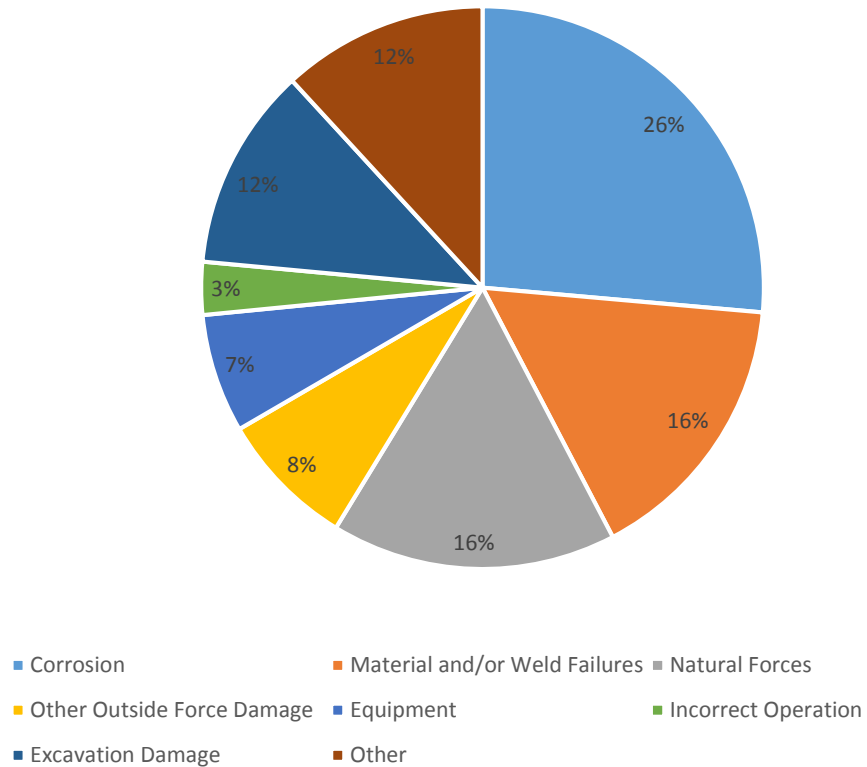
FATALITIES & INCIDENTS VS. YEAR



UG Research - Analysis of Natural Gas Pipeline Leaks (PHMSA data)

Transmission Pipelines: Sub Cause 2010 - Present

Transmission Pipelines: Cause of Incident
2002 -2009



Chemical Engineering Professional MS Program

- Combines advanced technical education, MBA-level management coursework, and open-ended research project to prepare students for careers in the chemical process industry
- Confers a terminal, non-thesis Masters of Science in Chemical Engineering in 12-months
 - Additional semester may be required, for students without ChE UG degree
- Choose from five areas of specialization: Kinetics, Catalysis, and Reaction Engineering; Biochemical Engineering; Energy System Fundamentals and Processes; Pharmaceutical Engineering; Polymer Science and Engineering
- Students conduct research on a project suggested by an industry sponsor, who agrees to mentor the team with weekly ~30 minute – 1 hour phone calls
 - Students are committed to work ~40 hrs / wk; ~1,200 hrs for a team of three
 - Work products are a ~20 page written report and presentation (any IP is maintained by sponsor)
- Past Industrial Partners: BP, Dow Chemical Co., ExxonMobil, **Eli Lilly**, **Kenexis**, Air Liquide, Sustainable Polymer Products
- Timeline:
 - Company commitment & project title: now
 - One page project description: Feb 1
 - Team / project matching: Feb 15 – March 15
 - Research: May 15 – July 31

Proposed P2SAC Research Projects

Modeling

- Re-examine current basis for gas & fire detector placement (BP); PhD Laird
- Validate large scale consequence modeling (BP); MS (Kenexis sponsor)
- Re-examine common cause models (BP, Honeywell)

Metallurgy / Corrosion

- Experience with LNG metallurgy failures (ExxonMobil); UG research
- Experience with corrosion under insulation and detection methods (BP); UG research
- Risk and reliability of aged gas and product pipelines (ExxonMobil, Laird); UG research
- Extend Charpy impact curves for brittle fracture of pipelines to different metallurgies (ExxonMobil)

Pharmaceutical

- Conduct a process safety related benchmarking survey of the pharmaceutical and perhaps broader industries (Lilly); UG research
- Compilation of thermal hazard safety data for amide coupling reagents (Lilly); MS (Lilly sponsor)
- Small-scale predictive tool for combustible dust prediction (Lilly)
- Develop a 'Safety by Design' concept incorporating lot-to-lot variability of reagents or solvents (Lilly)

Human Factors

- Human Performance of Control Room Operators (BP & ExxonMobil)
- Personnel competence in the major hazards industry (Phillips 66)
- Analysis of how past engineering design criteria accounted for normal human error mechanisms (Phillips 66)

Other

- Impact of modern personal electronic devices as potential ignition sources in process areas (ExxonMobil)
- Address validation of the use of water sprays to mitigate overpressures (ExxonMobil)
- Technology to detect subsea leaks (BP)

Faculty

- Computational analysis of drop coalescence in emulsions to reduce retention times in oil-water separators (Prof Basaran); *PhD*
- Develop strategies to make chemical processes inherently more cyber physically secure (Prof Pekny & Eric Dietz)
- Erosion in pipelines (Prof Basaran)
- State of the art battery design offering enhanced safety while yielding equivalent capacity as Li at higher potentials. (Prof Pol)

*Red represents portion of '17 research program

Questions?

Comments?

