

Purdue Process Safety & Assurance Center (P2SAC)

Overview

Ray A. Mentzer

**Professor of Engineering Practice
Associate Director, P2SAC**

Charles D. Davidson School of Chemical Engineering
Purdue University

December 3, 2024

December 2024 Conference Registration

Sponsors

ACC – Am Chem Council

AcuTech

AMGEN

Corteva

CountryMark

Curia Global

Dow

Endress+Hauser

Evonik

ExxonMobil

Fauske & Associates

GSK

Honeywell

Johnson Matthey

Kenexis

Lilly

Pfizer

PSRG

SABIC

Safety&

Thermal Hazard Tech

Vertex

Guests

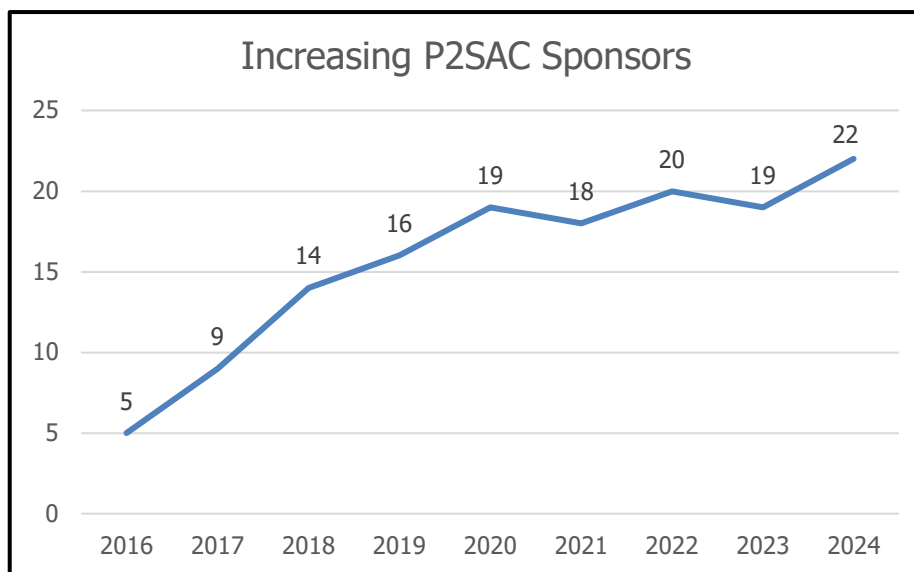
- CCPS
- Kiewit*
- Marathon Consulting
- Operational Sustainability*
- Safety Mgmt Group*
- Sandia Nat'l Labs
- Takeda*
- Univ of Illinois (UIUC)*

**denotes 1st meeting*

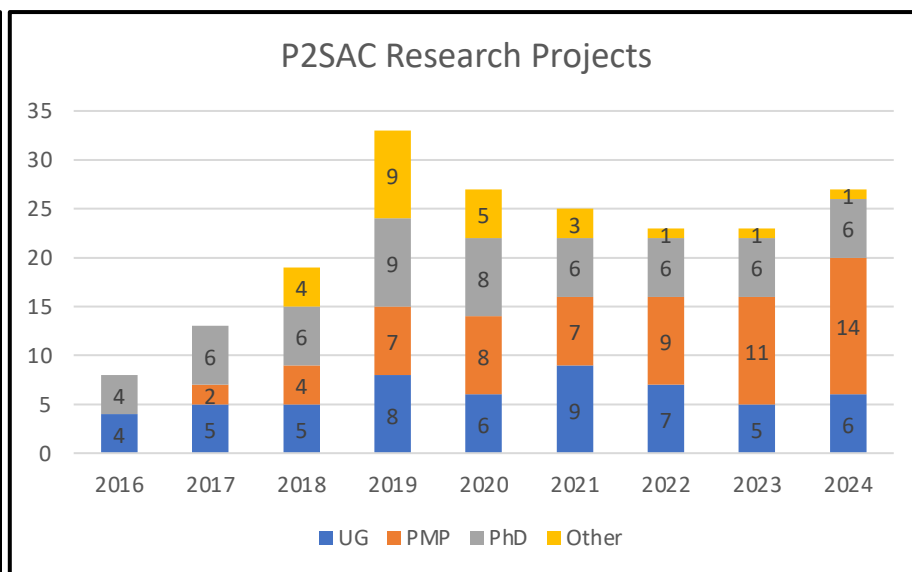
On-going dialog with other Depts:
ABE, CHEM, IE, IPPH & ME

Growing Industry Participation & Projects in P2SAC

Increasing P2SAC Sponsors



P2SAC Research Projects



ChE Professional Masters Program

Program Growth: 9 students in '15 / '16 academic year to 62 in Fall 2023 (34% female; 81% int'l)

Placement: \$86 – 90.5k avg starting salary 2024, 94% placement within 6 mos

Seven areas of concentration: Energy Systems Fundamentals & Processes; Kinetics, Catalysis, and Reaction Engineering; Biochemical Engineering; Polymer Science and Engineering; Pharmaceutical Engineering; Gas and Petroleum Engineering; Data Science

Program completion in one year:

Students take 2 core courses; 3 electives in area of concentration; 3 in Management;

6 Credit hour Capstone project

Additional semester required for those without BS in chemical engineering

Capstone projects are typically suggested and led / mentored by industry

Students remain on campus with ~30-minute weekly call with industry mentor

+400 hrs of 'free' research

Typically, 1/3 – 1/2 of summer projects process safety related; 14 students and 11 projects this fall

Companies participating: Abbvie, AcuTech, Allergan, Amgen, Biotech, BP, Bristol-Myers Squibb, Chevron, Cook, Corteva, Dow, Evonik, ExxonMobil, Fauske, GSK, Johnson Matthey, Kenexis, Lilly, Marsh, Merck, Pfizer, Phillips 66, PSRG, Safety & Consulting, Shell, Siemens, Vertex, Whirlpool, 3M

~ 6 students in off-campus paid internships each semester

Intern companies include: Tesla, Bayer, Catalent, GSK, RiKarton Inc., Electric Hydrogen Co, Eurofins, Regeneron Pharm.

Fall '24 UG & Masters Process Safety Research Projects

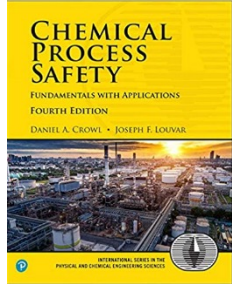
Professional MS Projects:

- Conducting Inherent Safety Design Studies Through AI-tool Integration - AcuTech
- Estimation of minimum safe gas purge rates for open vents and flares - ExxonMobil
- Comparison of predicted & experimental heats of decomposition for various reactions of interest to the pharmaceutical industry – GSK, Vertex, Amgen +3 others
- Estimation of Decomposition Energies for Organometallics – Johnson Matthey
- Advances in Management of Change in Hazardous Industries - Safety&
- Using Commercial AI Tools to Develop a HAZOP Augmentation and Automation Chatbot – Kenexis / Dow
- Ammonia as a Hydrogen Carrier - PSRG
- Site-specific decision trees for handling unstable materials – Evonik

- Two part-time PhDs & contract CS MS candidate engaged in NSF laboratory safety project since 2018

UG Projects:

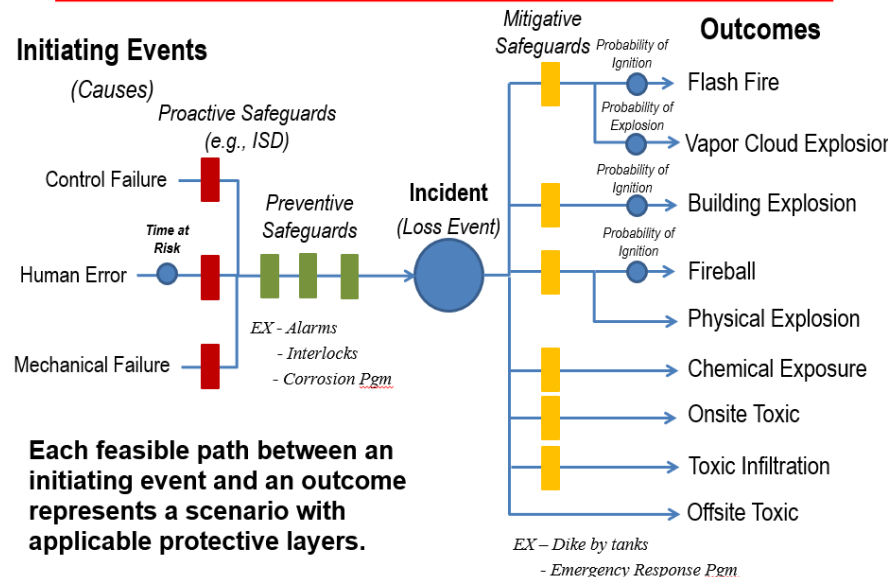
- Use of Electrochemistry to Reduce Reactivity Hazards - Mentzer & Tackett
- Investigating hazards Related to carbon Sequestration and Storage - PSRG



Chemical Process Safety - Core Class

- Personnel vs. Process Safety
- 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
- Emergency Response

Bow-tie Diagram



Chemical Facility Anti-Terrorism Standards (CFATS) ... and Chemical Security ...

Threat Spectrum



HAZOPs & Cyber Security

Threat	General Threat History	Specific threat history	Capability	Motivation/ Intent	Potential Actions	Overall Assessment	Threat Ranking
Cyber Attack	Previous cyberattacks like Triton, Maroochy water services breach, etc. have focused on targeting ICS components to cause significant physical and economic damages to the organization.	No history at this facility	Severe physical damage can be inflicted by cyber-attacks on the pressure controller (across TD-R), temperature controller (across TD-R and OLI-reactors) and the flow controller (TANK-1).	Sophistication of cyber criminals is out stripping the ability to effectively counter the attacks, resulting in increased malicious events, loss of data and physical damage.	Malicious intent, personal enrichment, political or religious motivation.	The exposure to these proposed small remotely operated gas processing plants assets by cyberattack was evaluated by the team and determined within the next 10 years that the cyber-attack potential on these facilities will make this a 'Medium' threat.	Medium

Benefits from Being P2SAC Sponsor

- Direct engagement in suggesting & selecting process safety research projects at all levels – PhD, PMP and UG.
- Priority in serving as mentor for process safety related Professional Masters Project of your choice.
- Attendance at biannual meetings to review research progress and learn from outside expert presentations.
- Sharing among companies of process safety learnings and challenges.
- Contact with students as they develop process safety expertise and enhance the science.



P²SAC PARTNERS

Lilly

AMGEN

Honeywell



KENEXIS



FAUSKE
& ASSOCIATES, LLC



3M

AcuTech
PROCESS RISK MANAGEMENT

سابك
sabik



CountryMark

Endress+Hauser
People for Process Automation



CORTEVA
agriscience

American
Chemistry
Council

ExxonMobil

JM Johnson Matthey
Inspiring science, enhancing life

PSCG
Process Safety and Reliability Group



EVONIK
Leading Beyond Chemistry



THT
THERMAL HAZARD TECHNOLOGY