SAFETY:
EXAMINING YOUR ENGINEERING RESPONSIBILITY

NJIT Student Section AIChE

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WHO AM I?

- Peter Sibilski, P.E., CEM, FAIChE
- Plant Manager, Pharmetic Manufacturing Co., LLC
- B.S., Chemical Engineering - NJIT
- MBA, Technology Management - University of Phoenix
- Work experience includes:
  - Diamond Shamrock – specialty chemicals
  - Occidental Chemical – specialty chemicals
  - Henkel Chemical – specialty chemicals
  - Olin Hunt – microelectronics chemicals
  - EI Associates – A/E consulting
  - BOC Gases – industrial gases
  - Schering-Plough - pharmaceuticals
  - ALZO International, Inc. – specialty chemicals

ATTRIBUTION

Information presented on these slides was obtained (with permission) from:

- **Ethics – Examining Your Engineering Responsibility** – Deborah L. Grubbe, P.E., CEng., FAIChE, FIChemE – CEP Magazine, February 2015

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Why is Safety Important to Engineers?

- **With one mistake an engineer can kill more people than any other professional.**

Hyatt Regency Skywalk Collapse

Incident Facts

- July 17, 1981
- 7:05 p.m.
- 2 walkways over hotel atrium collapsed during a tea party
- Construction difficulties resulted in walkway suspension system design change
- 114 dead / 219 injured

Hyatt Regency Walkway Collapse

- **Investigation Found**
  - **Original design found to support only 60% of minimum load required by Kansas City building codes**
  - **Havens Steel – contractor manufacturing support rods – objected to Jack D. Gillum & Associates' original design due to anticipated damage to rods during construction**
  - **Alternate plan proposed by Havens later found to support only 30% of minimum load**
  - **Problem was lack of proper communication between Havens & Gillum:**
    - *Drawings prepared by Gillum & Associates were preliminary sketches, interpreted by Havens to be finalized drawings*
    - *Gillum & Assoc. accepted Haven's alternate design without performing basic calculations that would have identified the design flaw*

Space Shuttle: *Challenger*

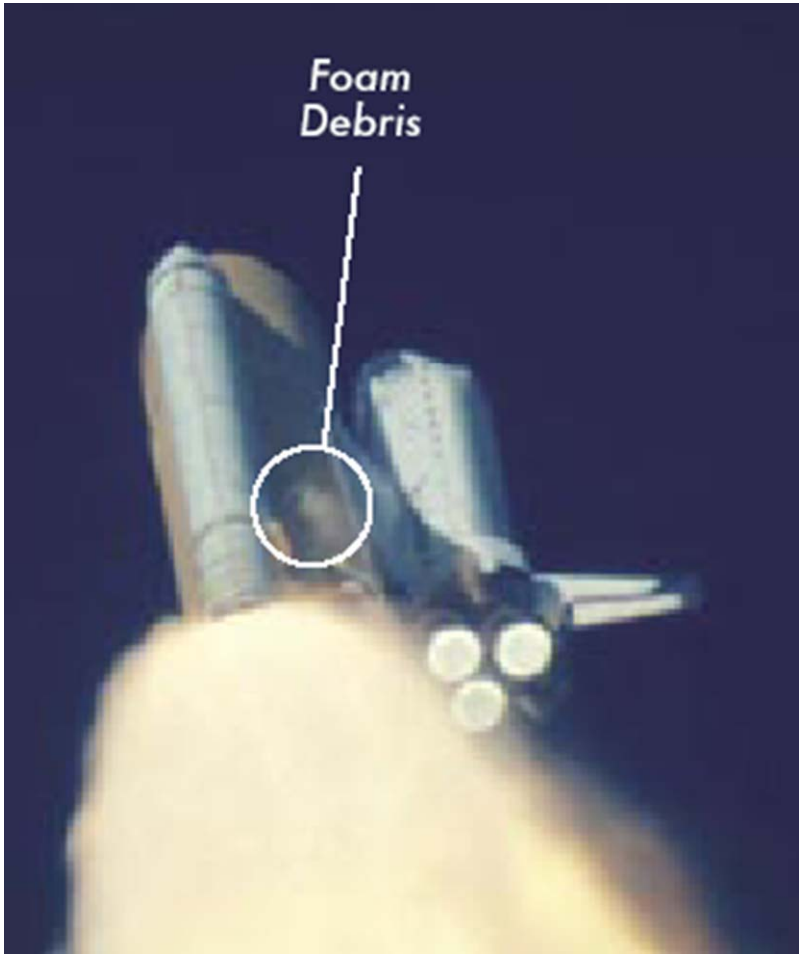
Incident Facts

- January 28, 1986
- T +73 seconds
- SRB O-ring joint fails
- SRB strut melts
- Explosion: 7 dead
- Rogers Commission
- “Prove to me it is safe”
- “Go Fever”

Space Shuttle: *Challenger*

- **Rogers Commission Found**
  - NASA had long known about recurrent damage to O-rings
  - Increasing levels of O-ring damage tolerated over time: Based upon rationale that *"nothing bad has happened yet"*
  - SRB experts had expressed concerns about the safety of the Challenger launch (deferring to technical experts)
  - NASA's culture prevented these concerns from reaching top decision-makers (communication patterns, culture)
  - Past successes had created an environment of over-confidence within NASA (complacency)
  - Extreme pressures to maintain launch schedules may have prompted flawed decision-making

Space Shuttle: *Columbia*



Incident Facts

- February 1, 2003
- Insulating Foam
- Dislodged T+81 Seconds
- Damaged Thermal Tiles
- Engineers asked 8 times for pictures
- Launch +16 days
- Shuttle Disintegrated Upon Re-Entry

Space Shuttle: *Columbia*

- **CAIB Found**
  - **NASA had long known about foam damage dangers**
  - **Levels of foam damage tolerated over time: Based upon rationale that *"nothing bad has happened yet" and foam was viewed as a turnaround issue, not as a flight safety issue***
  - **Engineers had expressed concerns (8x) about the safety of the Columbia launch (deferring to technical experts)**
  - **NASA's culture prevented these concerns from reaching top decision-makers (communication patterns, culture, "B" team)**
  - **Past successes had created an environment of over-confidence within NASA (complacency)**
  - **Leadership issues: "Tone at the Top"**

Space Shuttle: *Columbia*

Safety Culture

"In our view, the NASA organizational culture had as much to do with this accident as the foam."

Columbia Accident Board Report, Volume 1, Page 97

BP Texas City Explosion

Incident Facts

- March 23, 2005; 15 dead, > 170 injured
- Column overflow on startup
- Trailer placement
- Shift handover
- Supervisor Accountability
- Communications
- Culture

BP Internal Investigation

- **Baker Panel**
  - Modeled after the Columbia Accident Investigation Board
  - The Baker-led panel, announced in October 2005, traveled to BP's five U.S. refineries, interviewed more than 700 employees and reviewed more than 340,000 pages of documents. The panel also surveyed about 7,500 employees and contract workers to assess their attitudes of BP's process safety culture.
  - The 300-plus page report said the company emphasized personal safety over what it called "process safety," or containing potential hazards such as explosions.
  - The panel ultimately made 10 recommendations, including that an independent monitor report to the company's board of directors for five years.

Deepwater Horizon

Incident Facts

- April, 2010
- Offshore Louisiana
- Hi Pressure Reservoir
- Under cost pressure
- Relative inexperience
- Culture
  - Communications
  - Ops knowledge

Deepwater Horizon Study Group

- **Investigation**
  - **The accident report concluded that no single action caused the incident – it was a culmination of a complex interaction of mechanical failures, human judgments, engineering design, operational implementation and team communication**
  - **The DHSG (Deepwater Horizon Study Group) analysis indicated that this disaster was preventable if existing progressive guidelines and practices been followed—the Best Available and Safest Technology (BAST)**
  - **(DHSG) analysis of the available evidence indicated that when given the opportunity to save time and money—and make money—poor decision making played a key role in accident causation**

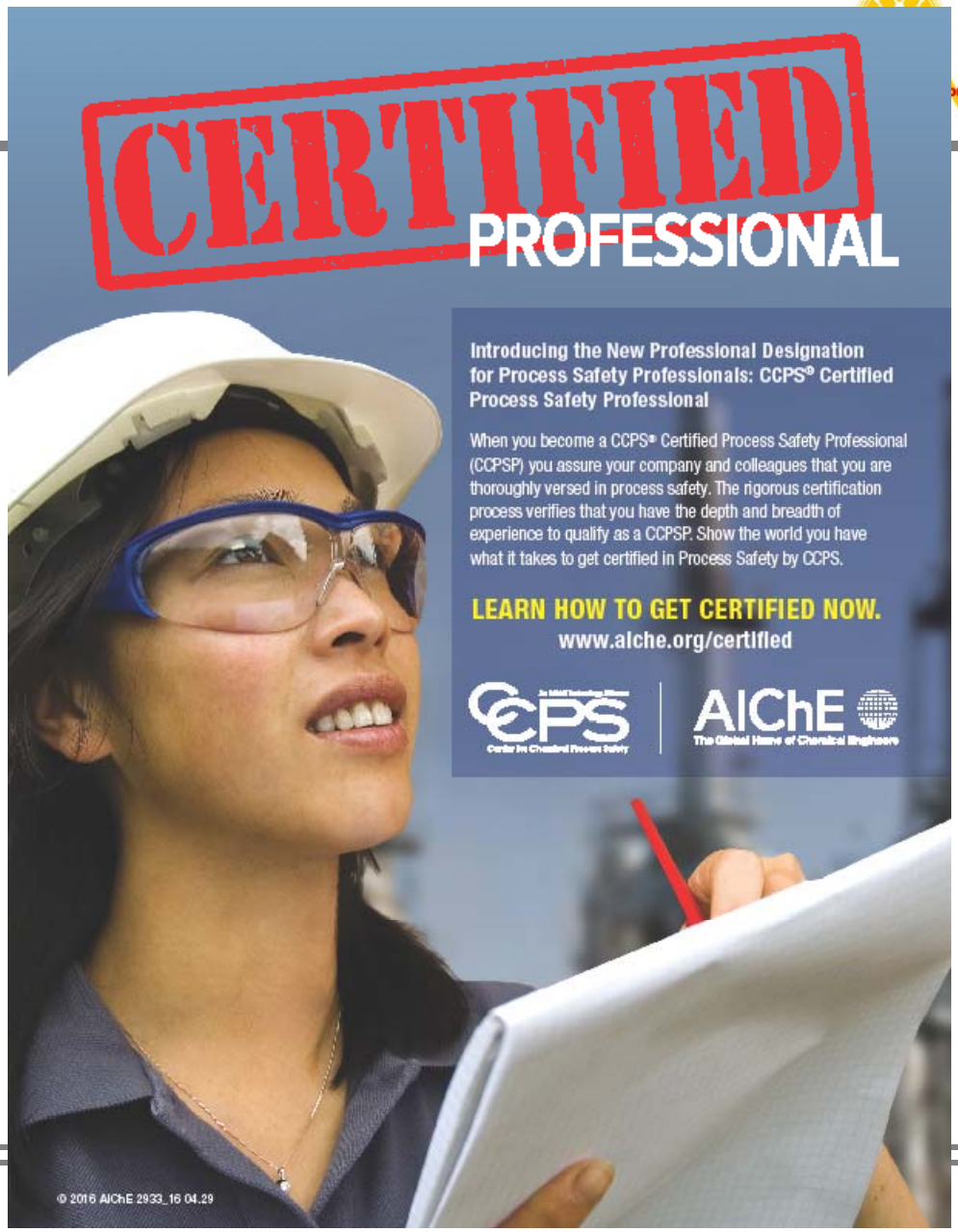
Case Study Take-Aways

- **All case studies reviewed have, at their roots, inadequate non-technical communication and thought patterns**
- **Another common element – *unsteady-state operation***
  - ***Skywalk exposed to larger than expected dynamic loads due to partiers dancing on them***
  - ***Astronauts didn't die in space – they died going up or coming down***
  - ***Refinery explosion occurred during start-up***
  - ***Oil well explosion occurred as the well was being secured after drilling was completed***

What's New at CCPS?

CCPS Certified Process Safety Professional

Launched April 10, 2016



AIChE Process Safety Workshop for University Faculty

AIChE NORTH NJ WHERE TECHNOLOGY CONNECTS

Purpose: To provide an introduction to engineering faculty on how process safety impacts the management, design and operation of a chemical plant.

Outcomes: The workshop will enable faculty to teach process safety in their undergraduate and graduate curricula so that graduating students will have a basic understanding of process safety for their careers in industry.

Scope: The course will provide an overview of basic concepts in risk management systems and technical competencies required to prevent loss of containment of highly hazardous chemicals and materials.

Target Audience: All faculty in chemical, biochemical, materials, and mechanical engineering.

- Workshop Duration: 3 days
- Expected # of Attendees: 20-30 faculty
- Total Cost: $40K

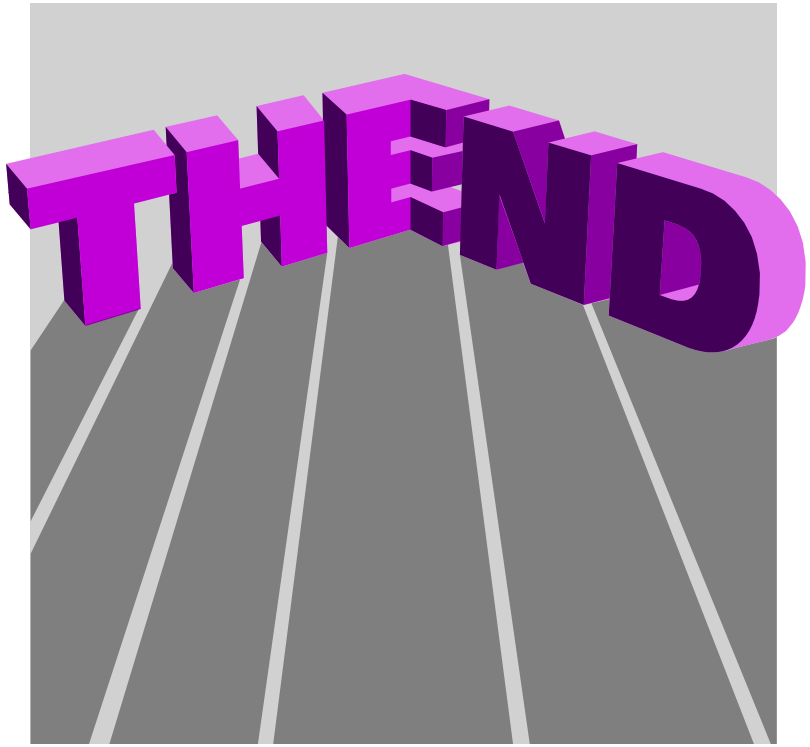
AIChE Students Process Safety Boot Camp

Purpose: To provide an introduction to engineering students on how leading companies across a variety of chemical process industry (CPI) sectors manage Process Safety so as to prevent catastrophic accidents involving toxic, highly reactive, and flammable materials.

Scope: The course will provide an overview of basic concepts in risk management systems and technical competencies required to prevent loss of containment of highly hazardous chemicals and materials.

Target Audience: Undergraduate students in their junior or senior year and graduate students in chemical, biochemical, materials, and mechanical engineering who hope to work in CPI process/plant design and manufacturing operations in the oil and gas/refining sectors, food manufacturing/storage, commodity chemicals and polymers, pharmaceuticals / nutraceutical, pulp and paper, or specialty chemicals sectors.

- Boot Camp Duration: 2 days
- Each Boot Camp instructor has over 30 years of experience in the chemical, petrochemical, food or pharmaceutical industries
- Expected # of Attendees: 20-30 students
- Total Cost: $25K


THE END

"There is no expedient to which a man will not resort to avoid the real labor of thinking."

Sir Joshua Reynolds

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