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NIOSH

5 December 2017

PtD™
Prevention through Design

Purdue Process Safety & Assurance Center

CDC Workplace Safety and Health NIOSH

DISCLAIMER: *The findings and conclusions in this presentation have not been formally reviewed by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.*

Relax, NIOSH is not OSHA

- Occupational Safety and Health Administration (OSHA) [www.osha.gov]
  - Part of the Department of Labor
  - Sets and enforces standards
- National Institute for Occupational Safety and Health (NIOSH) [www.cdc.gov/niosh]
  - Part of the Department of Health and Human Services
  - Conducts research and makes recommendations for the prevention of work-related injury and illness

Photo courtesy of Thinkstock

What is it?

Anticipating **and** ***DESIGNING OUT*** **hazards in tools, equipment, processes, materials, structures, and the organization of work is** ***the most effective way*** **to prevent occupational injuries, illnesses, and fatalities.**

John Howard, MD

Director, NIOSH, CDC

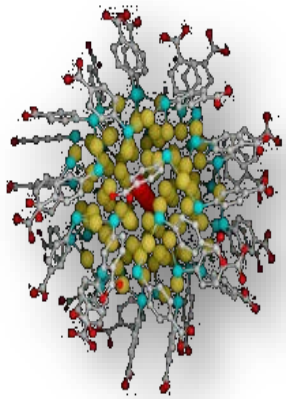
May, 2014

NIOSH Prevention through Design Initiative

Mission: ***Design out*** hazards and minimize risks associated with:

Tools & Equipment

Processes

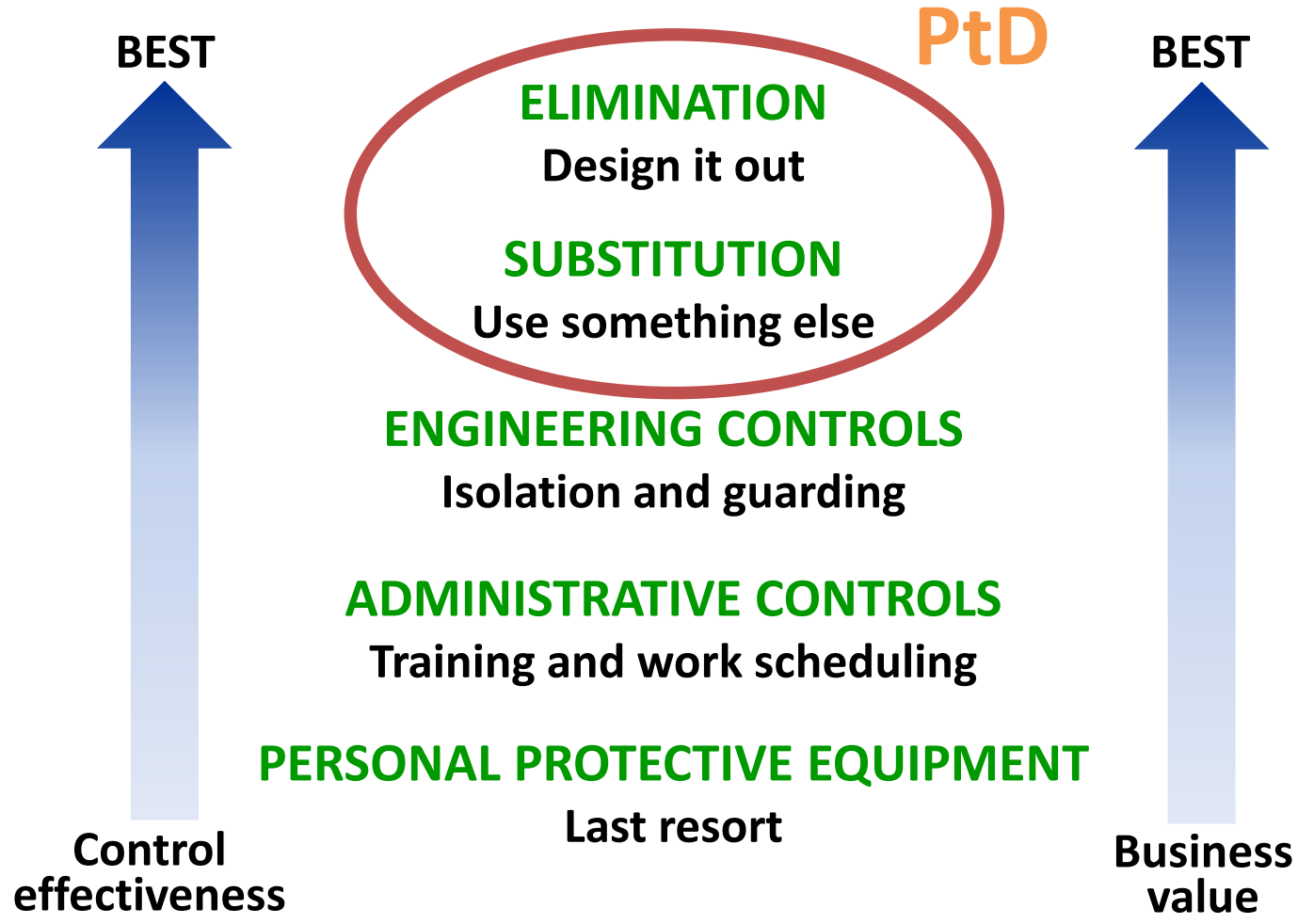


Materials, Products, New Technologies

Structures

Organization of Work

Hierarchy of Controls ANSI/AIHA Z10

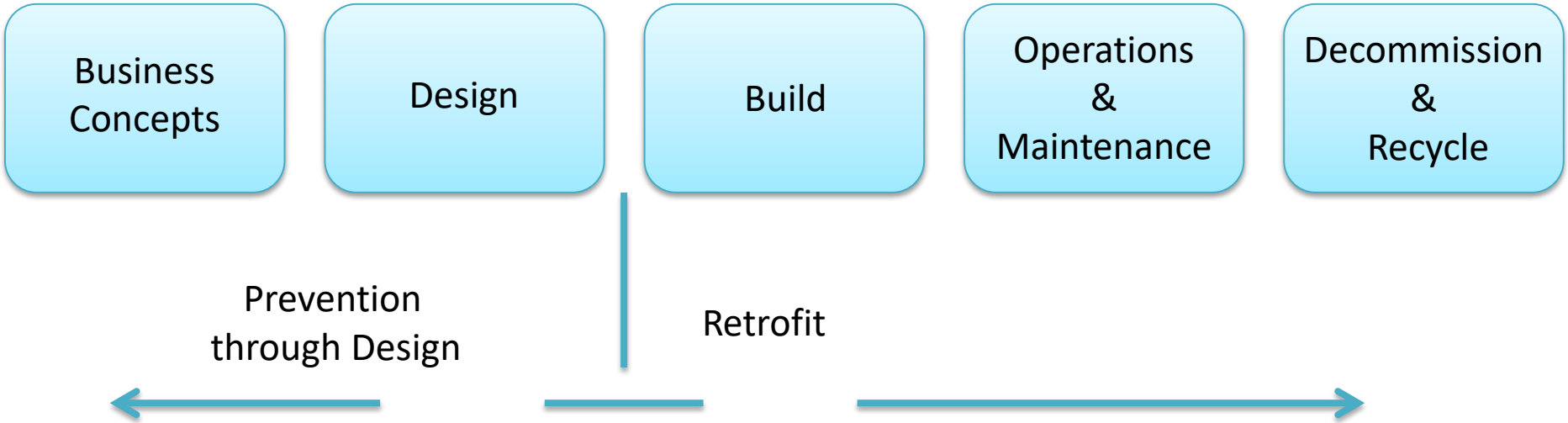


1st - the PRIORITY

Moving Upstream

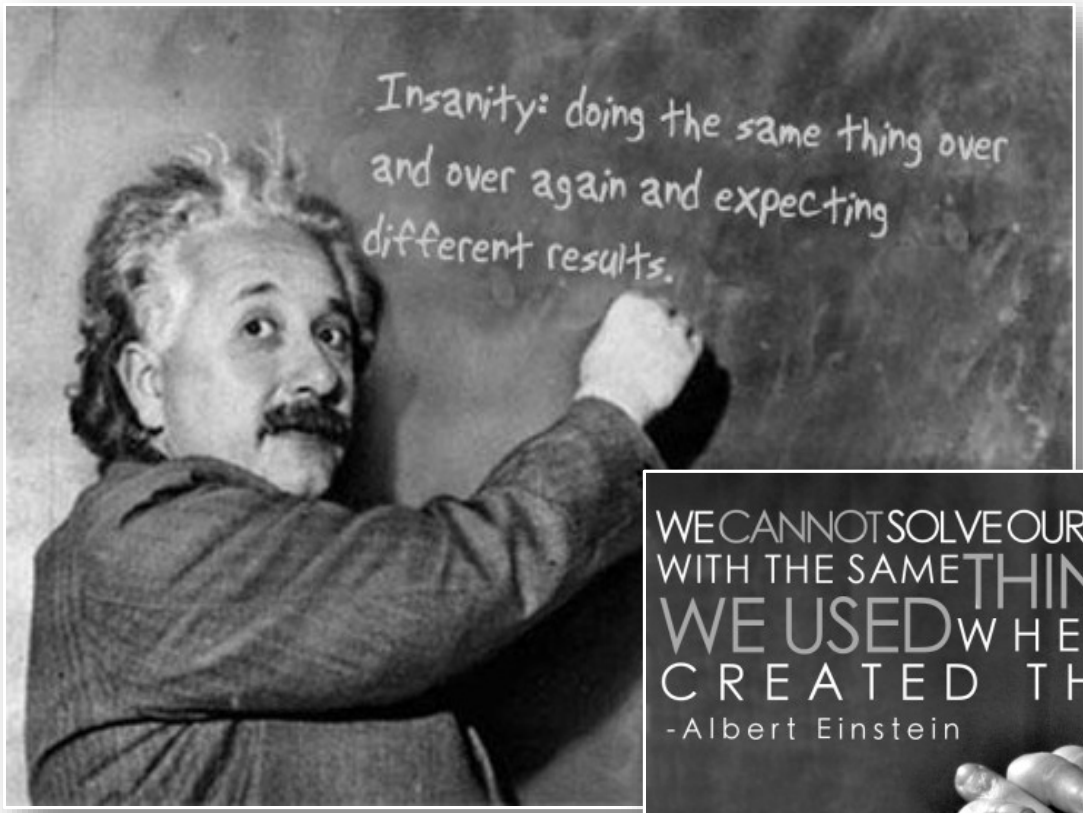
PtD

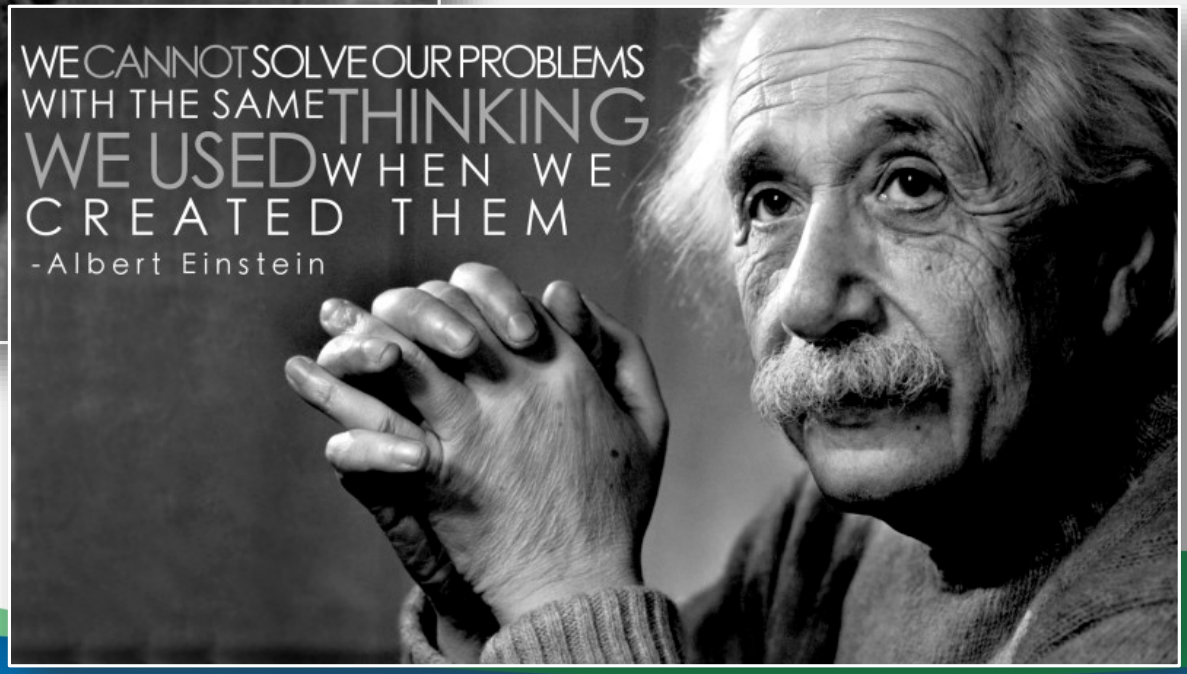
Move Hazard Elimination Upstream in Design Process



To move worker protection from an afterthought to a forethought in process, product and facility design

A process for *Fresh Thinking*





Agenda

- PtD & the National Initiative – *Burden, Need, Impact*
- Policy History and Current Trends
- How to *Change* your *Culture* to *Prevention*
- What do you do next?
- SO What ?

The U.S. Burden is Large

- 3.7 million work-related injuries per year [1BLS 2014]
  - 4,679 deaths from injury [2BLS 2014]
- 189,400 work-related illnesses per year [1BLS 2014]
  - 47,000 deaths from illness [ ]
- Tremendous personal/societal health impacts:
  - Untold pain and suffering for workers and families
- $250 billion per year in direct and indirect costs[3]

[1]Bureau of Labor Statistics, BLS, Nonfatal News Release, www.bls.gov/iif/

[2]Bureau of Labor Statistics, BLS, Fatal News Release, www.bls.gov/iif/

[3]Leigh 2011 - based on 2007 illness & injury rates, www.ncbi.nlm.nih.gov/pubmed/22188353

The World Burden is Huge

The United States:

- 3.72 million work-related injuries & illnesses/year
- About 51 thousand deaths/year – 142 per day.

The World:

- 317 million work-related injuries & illnesses/year
- Over 2.3 million deaths/year – 6300 per day. [1ILO 2016]

[1]International Labor Organization, 20 July 2016, www.ilo.org/global/topics/safety-and-health-at-work/lang--en/index.htm

The NEED: Design *is* a Risk Factor

- Australian Study, 2000–2002
- Main finding: design contributes significantly to work-related serious injury
- **37%** of workplace fatalities are due to design-related issues
- In **another 14%** of fatalities, design-related issues may have played a role

[Driscoll et al. 2008]

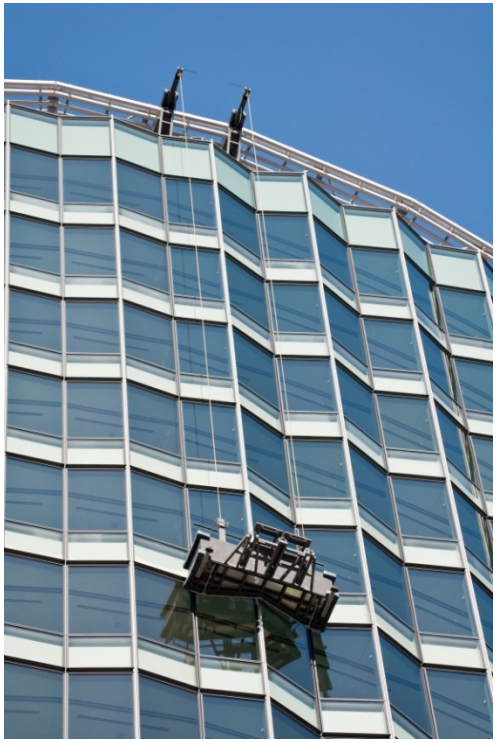


Photo courtesy of Thinkstock

The NEED: Design *is* a Risk Factor

- **22%** of 226 injuries that occurred from 2000 to 2002 in Oregon, Washington, and California were linked partly to design [Behm 2005]
- **42%** of 224 fatalities in U.S. between 1990 and 2003 were linked to design [Behm 2005]
- In Europe, a 1991 study concluded that **60%** of fatal accidents resulted in part from decisions made before site work began [European Foundation for the Improvement of Living and Working Conditions 1991]
- **63%** of all fatalities and injuries could be attributed to design decisions or lack of planning [CHAIR safety in design tool 2001]

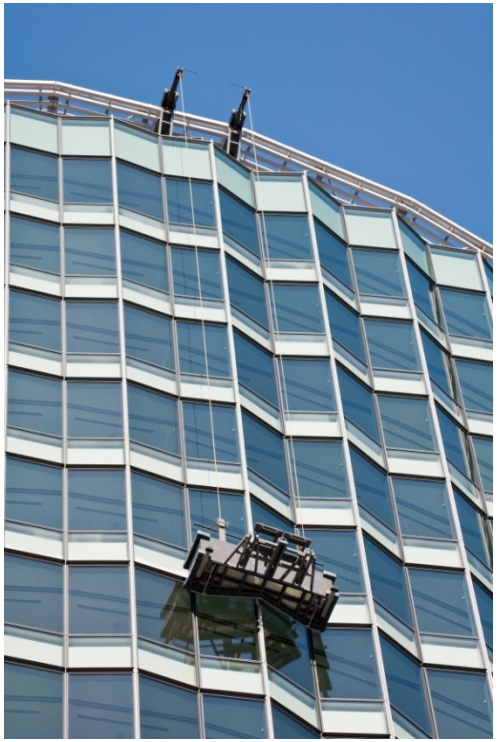
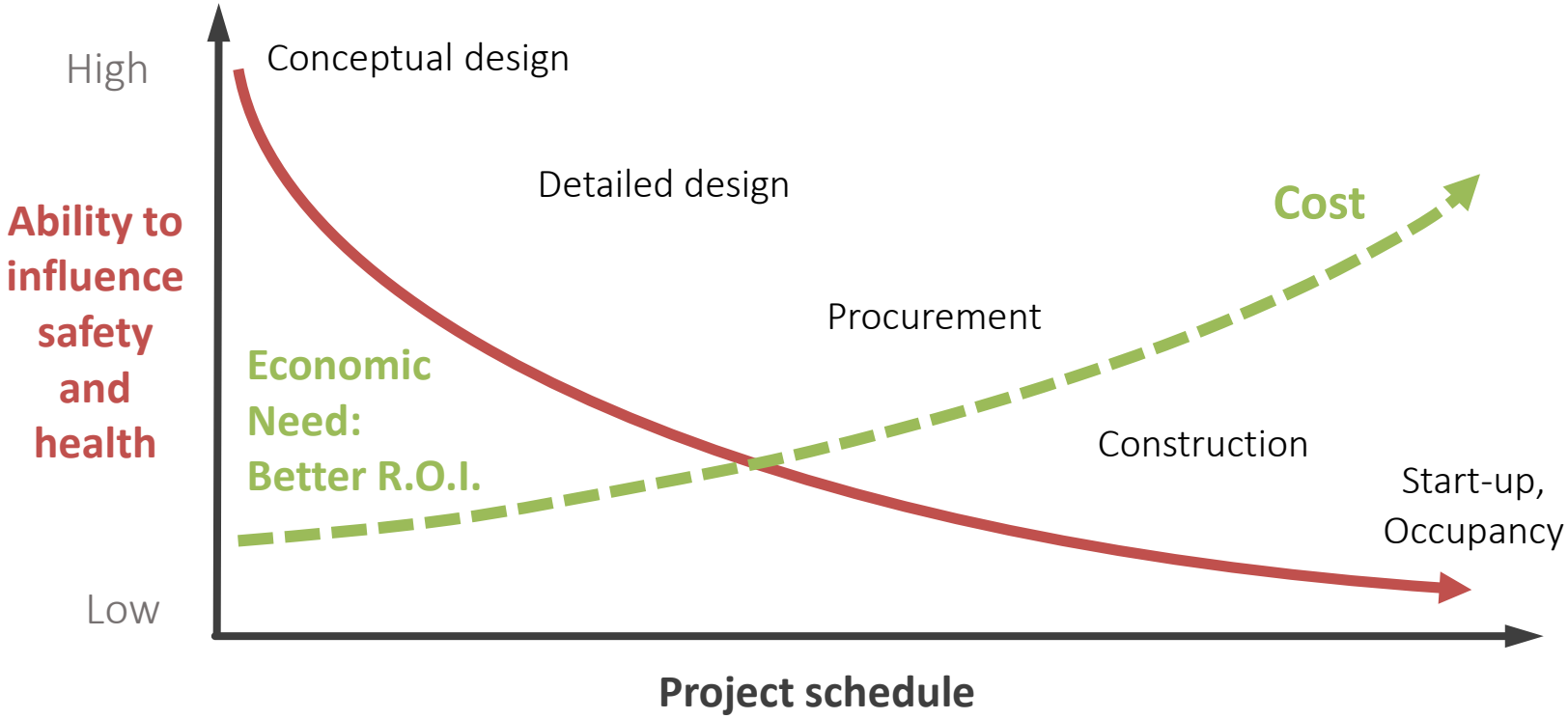


Photo courtesy of Thinkstock

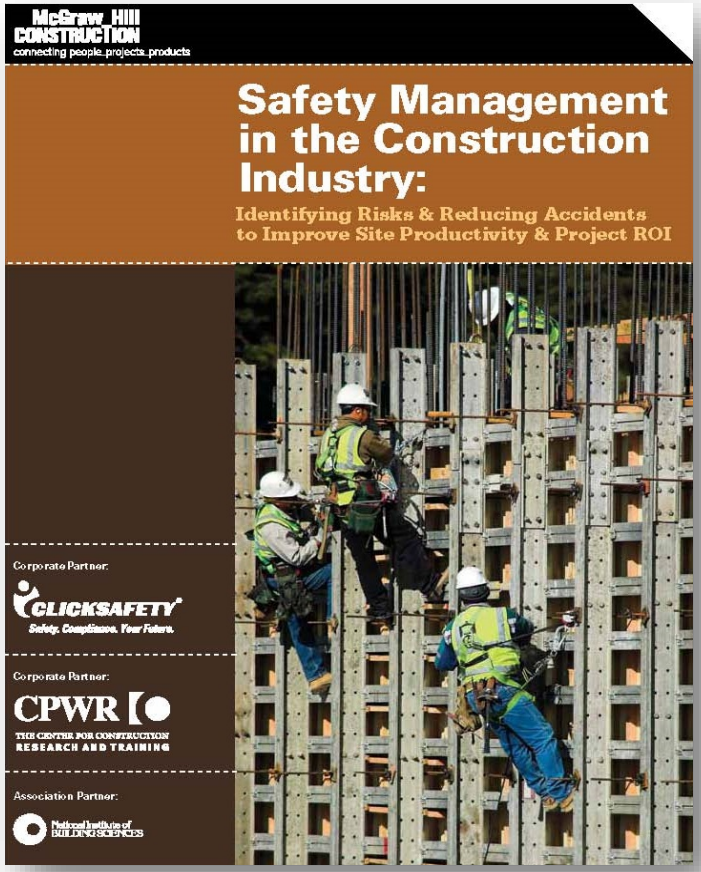
The NEED: Bang for the Buck



(Adapted from: Szymberski, R., "Construction Project Safety Planning." TAPPI Journal, Vol. 80, No. 11, pp. 69-74.)

VIDEO CLIP

The NEED: Complexity requires a PROCESS



"Over the last 20 years the practice of construction has undergone profound changes. … new technologies, such as building information modeling (BIM), have enabled projects to become more ***complex***.

Therefore it is *essential* … to have a **fully integrated**, extensive safety **program** that can respond to evolving industry needs and allow them to stay ***competitive***. … "

(A specific planning and design PROCESS)

Agenda

- **PtD & the National Initiative** – *Burden, Need, Impact*
- **Policy History and Current Trends**
- **How to *Change* your *Culture* to *Prevention***
- **What do you do next?**
- **SO What ?**

PREVENTION THROUGH DESIGN!

Design it out!

What is PtD?

The NIOSH Prevention through Design (PtD) initiative seeks to promote the practice of eliminating or reducing worker hazards early in a project process, in the design phase.

PtD encompasses efforts to anticipate and design out hazards to workers in facilities, methods, operations, processes, equipment, tools, products, technology and the organization of work.

Remember the Hierarchy of Controls

E.S.C.A.P.E Workplace Hazards

PtD favors the top end of the hierarchy of controls; Preferring to "design out" hazards at the start, reducing reliance on personal protective equipment.

Higher — Priority — Lower

- **E**liminate Hazards
- **S**ubstitute Lesser Hazard
- **C**ontrol Technologies
- **A**dministrative Controls
- **P**rotective **E**quipment

National Initiative

Hundreds of stakeholders from each industry sector collaborated to develop 32 intermediate and 52 research goals for the promotion of PtD methods and philosophy.

Read the entire strategic plan here! goo.gl/BYeh3b

View the "State of the National Initiative" in full! goo.gl/GKpMF

PtD is divided into **5** strategic areas of focus, shown below

The PtD initiative needs your input to inform our priorities. Send us your ideas to improve workplace health and safety by design!

Education

Strategic Goal

To encourage designers, engineers, health professionals, businesses, and workers to understand and use PtD.

Curricula

PtD has been taught at many universities.

Examples of universities that teach PtD

- Harvard University
- Oregon State
- Bucknell University
- Purdue University
- Virginia Commonwealth
- University of Utah
- University of Alabama
- U-Mass Lowell
- Virginia Tech

Textbooks

Over 78 textbooks include PtD topics.

Educational Modules

PtD educational modules are easily integrated into any engineering or design curriculum.

Research

Strategic Goal

To measure the value of adopted PtD solutions, address existing design-related challenges, and suggest areas for future research.

Lessons from Abroad

A study of legally-mandated PtD in the United Kingdom and Australia informs recommendations for the United States

Progress at the top

A study of Fortune 200 firms shows high rates of adoption of PtD.

80% of Fortune 200 firms are aware of PtD concepts

77% of Fortune 200 firms utilize PtD concepts

Source goo.gl/DKpNF

Green Industry

Workshops have been held for the "Green" industries to promote the concept. "Green" should not be limited to environmental factors, but must include the wellbeing of workers.

"Making Green Jobs Safe" goo.gl/3Dvng7

Nanotechnology

A workshop was held for the growing nanotech industry to review new hazards that may be addressed using PtD, even molecular design!

"Perspectives on Safer Nanomaterials" goo.gl/7TtUt2

Practice

Strategic Goal

To ensure stakeholders access, share, and apply successful PtD practices.

Workplace Design Solutions

NIOSH has created a series of concise, easy to use guides that translate NIOSH research into useful workplace practices. More are in development, including Nanotechnology.

Get your solution! goo.gl/A0GMjV

Unsure how to put PtD into practice?..

Go for it!

"Leverage" Ergonomics

Solve a clear ergonomic problem that is well understood and appreciated. Explain how this is PtD in action and go from there.

Start Design Safety Reviews (DSR)

Gain management support. Explain how adding safety reviews to design, and end-users and safety experts to the team, brings "lessons learned" and better solutions.

Follow the "Process"

Using checklists, experience, and brainstorming, the DSR team lists hazards and ranks the risks, then works to eliminate many during design. For guidance, use the ANSI z590.3 standard!

Help Designer's Liability Concerns

Show designers smart ways to do PtD while limiting their liability. For assistence please contact Jonathan Bach at jbach@cdc.gov

Do Incident Investigation Differently

Focus on fact finding not fault finding. Don't stop when you find the error, start there. Identify the systemic conditions that made the error possible.

More goo.gl/PGbPMP

Put PtD into Institutional Memory

Include PtD methods and equipment choices into contract provisions, purchasing specs.

Policy

Strategic Goal

To prompt business leaders, labor, academics, government, and standards groups endorse a culture that includes PtD principles in design.

New Standards

The American National Standards Institute (ANSI), American Society of Safety Engineers (ASSE), and American Industrial Hygiene Association (AIHA) have published two key PtD consensus standards.

1. ANSI/ASSE z590.3 focused on the PtD design processes.
2. ANSI/AIHA z10 integrates PtD into Occupational Health and Safety Management Systems.

LEED Building Credits

U.S. Green Building Council offers credits for PtD in the "Leadership in Energy and Environmental Design" rating system.

More goo.gl/B8fmma

Small Business

Strategic Goal

To provide small businesses must have access to PtD resources that are appropriate for their needs.

Putting Research to Work!

Facilitate the transfer of research findings to usable methods, practices, and products.

Outreach Efforts

Not all firms are large enough to implement PtD themselves.

NIOSH provides resources to key partners to facilitate adoption.

- Trade Associations
- Equipment Suppliers
- Insurance Companies
- Chambers of Commerce

SUCCESS! for Small Businesses

Reduced volotile organic compounds exposure in asphalt paving.[1]

Reduced musculoskeletal injury in grape harvesters.[2]

More at NIOSH Workplace Design Solutions

Show the Benefits

Pictures are worth a thousand words.

- NIOSH Education modules
- designforconstructionsafety.org

Rate, and Raise, your Safety Culture

More cpwr.com/safety-culture

Give Management the Business (Case)

Make your case for the financial and non-financial benefits of PtD. Guidance & resources:

- OSHA's "Safety Pays"
- CPWR ROI Calculator
- AIHA Value Strategy
- More to come from NIOSH

NIOSH

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Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

References

1. Acott, M. (2011) Catching lightning in a bottle. Plenary session at Prevention through Design - a new way of doing business: a report on the National Initiative, Washington, DC. August 22-24

2. Wolfe, A. (2011) Improving the lives in wine grape harvesting industry through PtD, at Prevention through Design - a new way of doing business: a report on the National Initiative, Washington, DC. August 22-24

PPOP Program Performance One-Pager

www.cdc.gov/niosh/docs/ppop

NIOSH Prevention through Design Initiative

May 2016

What are our priorities?

The National Institute for Occupational Safety and Health (NIOSH) Prevention through Design (PtD) Initiative works with partners in industry, labor, trade associations, professional organizations, and academia. The program focuses on preventing illness, injury, and fatality by "designing out" occupational hazards and risks.

What do we do?

- **Research** the effectiveness of current PtD interventions, investigate additional solutions for existing design-related challenges, and identify future research needs.
- **Educate** and motivate others to use PtD priorities and processes in collaborative design and redesign of facilities, work processes, equipment and tools by:
  - Helping universities integrate PtD principles into engineering curricula.
  - Encouraging professional accreditation bodies to include PtD in their assessments.
  - Making business leaders aware of potential cost savings from PtD.
- Increase **practice** of PtD by sharing case-studies of real-life PtD solutions, and encouraging stakeholders to apply them and share further.
- Encourage business, labor, government, academic, and consensus standards organizations to integrate PtD into **policy** revisions.
- Produce concise, practical PtD guides and checklists for **small businesses**, their insurers, and the publishers of code books used by their local municipalities.

What have we accomplished?

- The U.S. Green Building Council published a *Leadership in Energy & Environmental Design (LEED) PtD pilot credit* for building certifications after four years of **policy** work with the NIOSH PtD and Construction programs. The pilot credit, developed by NIOSH, prompts the use of PtD methods to design out worker hazards for both the construction phase and operations & maintenance phase of a building's life cycle.
- Completed **research** and development of a Business Case Developer software tool that helps business managers and safety and health professionals develop proposals on the business advantages of transitioning to a PtD design process.
- Provided **education** in PtD methods at 17 events to over 1,000 influencers in business, safety, health, government, academia, and labor.
- Published safe **practice** outcomes of the 2012 "Safe Nano Design" workshop organized by the NIOSH PtD program, the NIOSH Nanotechnology Research Center, and the State University of New York at Albany. The focus is on safer design of both molecules and manufacturing processes.
- Published two Workplace Design Solution documents on PtD business value and noise reduction. These brief documents are especially helpful to **small businesses**.

What's next?

- Publish Capital Projects Processes web site with checklists and case studies showing how to incorporate PtD methods in large building projects, including Green Building.
- Publish a Business Case journal article that shows how to use the free Business Case Developer software. It can be used to make financial and non-financial proposals for adoption of PtD processes in a business.
- Develop 8 or more case studies that provide more examples of how to use the Business Case Developer software.
- Publish 3 educational slide decks with speaker notes and instructor guides on PtD for Engineering undergrad programs in:
  - Agricultural Engineering
  - Capital Projects Process
  - Manufacturing and Industrial Engineering
- Develop model language for incorporating PtD into liability insurance policies for designers and constructors.
- Develop model contract language that incorporates PtD roles and responsibilities into design and construction contracts.
- Serve on the American Society of Safety Engineers' workgroup to revise the ANSI/ASSE z590.3 Prevention through Design standard. Revisions will provide guidance to better enable businesses to use PtD design methods.
- Publish two Workplace Design Solutions for nanotechnology manufacturing with the NIOSH Nanotechnology Research Center.

DHHS (NIOSH) Publication No. 2016-130

At-A-Glance

The Prevention through Design (PtD) Initiative's mission is to prevent or reduce occupational injuries, illnesses, and fatalities through the inclusion of prevention considerations in all designs that impact workers. This snapshot shows recent accomplishments and upcoming work.

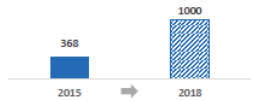
Visits to PtD topics/publications web page

Source: NIOSH program records

Projects using PtD LEED® Credits

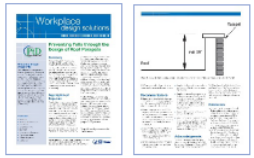
Source: NIOSH program records

PtD LEED® Webinar Participants



Source: NIOSH program records

Publication Spotlight: Workplace Design Solutions



NIOSH Prevention through Design Program

May 2017

DRAFT

What are our priorities?

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What do we do?

- **Research** the effectiveness of current PtD interventions, investigate additional solutions for existing design-related challenges, and identify future research needs.
- **Educate** and motivate others to use PtD priorities and processes in collaborative design and redesign of facilities, work processes, equipment and tools by:
  - Helping universities integrate PtD principles into engineering curricula.
  - Encouraging professional accreditation bodies to include PtD in their assessments.
  - Making business leaders aware of potential cost savings from PtD.
- Increase **practice** of PtD by sharing case-studies of real-life PtD solutions, and encouraging stakeholders to apply them and share further.
- Encourage business, labor, government, academic, and consensus standards organizations to integrate PtD into **policy** revisions.
- Produce concise, practical PtD guides and checklists for **small businesses**, their insurers, and the publishers of building code books.
- Advocate **lifecycle sustainability** to address health & safety for all occupants or users. The U.S. Green Building Council's *Leadership in Energy & Environmental Design* (LEED®) PtD credits now cover construction and operations and maintenance (O&M) occupants.

What have we accomplished?

- Developed model contract language that incorporates PtD roles and responsibilities into design and construction contracts.
- Developed model language for incorporating PtD into liability insurance policies for designers and constructors.
- Developed 8 industry case studies of successful PtD use, including a business case analysis.
- Collaborated and presented PtD methods at 10 events to hundreds of professionals in business, safety, government, and academia.
- Collaborated with and provided detailed input to OSHA's Sustainability in the Workplace group, contributing to the OSHA White Paper and website.
- Collaborated on PtD integration efforts with key industry, academic, and government leaders (e.g. OSHA, Green Chemistry & Commerce Council, American Ladder Institute, Arizona State University's Global Safety Center, Purdue Process Safety & Assurance Center, U.S. Army Corps of Engineers, LJB Engineering).

What's next?

- Develop 4 construction case studies of successful PtD use with business case analysis.
- Publish a journal article that shows how to use the free, NIOSH-developed Business Case Developer software to make proposals for adoption of PtD processes in a business.
- Publish a Workplace Design Solution for nanotechnology manufacturing with the NIOSH Nanotechnology Research Center.
- Publish a series of 8 to 12 industry PtD Case Studies including business case evaluations.
- Participate in consensus standards revisions (ANSI/ASSE z590.3, ANSI/AIHA z10)
- Publish PtD curricula slides and instructor guides for Engineering undergrad programs in:
  - Agricultural Engineering
  - Manufacturing and Industrial Engineering
  - Nanotechnology
  - Chemical Process Safety
- Publish a Capital Projects Processes web site with resources showing how to incorporate PtD methods in large building projects..
- Publish a Current Intelligence Bulletin, e-Tool, Toxicology Primer, training and education, and a Topic Page for the proposed NIOSH Occupational Exposure Banding process.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

DHHS (NIOSH) Publication No. 2017-XXX
www.cdc.gov/niosh/topics/ptd

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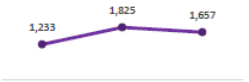

Source: NIOSH program records

Projects using PtD LEED® Credits

Source: NIOSH program records

LEED® Professionals Earning PtD CEU's

Source: NIOSH program records

Publication Spotlight: Education Modules

What's next in NIOSH PtD?

- Capital Projects Processes Website (checklists, templates, model programs, etc)
- Business Case Developer Software and Manuscript
- Case Studies (with business case summaries)
- New Educational Modules (Agricultural Engineering, Manufacturing & Industrial Engineering, Capital Projects, Nanotechnology, Chemical Process Safety)

NIOSH reviews complete. Revising for Peer/Stakeholder reviews.

[Photo courtesy of Thinkstock]

PtD Prevention through Design

Chemical Process Safety

EDUCATION MODULE

Developed by Carol Clinton, PhD, PE
Jonathan Burkhardt
University of Cincinnati

CDC Workplace Safety and Health NIOSH

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- **How to *Change* your *Culture* to *Prevention***
- **What do you do next?**
- **SO What ?**

PtD is NOT new …

1750 B.C., Code of Hammurabi, Law 229: *"If a builder builds a house for someone, and does not construct it properly, and the house which he built falls in and kills its owner, then that builder shall be put to death."*

(Punitive code. *PtD implied!*)

Code of Hammurabi

Hammurabi 2.0

"My company has had a safety program for 150 years. The program was instituted as a result of a French law requiring an explosives manufacturer to live on the premises ***with his family****."*

— Crawford Greenwalt
Former president of DuPont

PtD is NOT new …

1440 B.C., Bible, Moses, Deuteronomy 22:8: *"When you build a new house, make a parapet around your roof so that you may not bring the guilt of bloodshed on your house if someone falls from the roof."*

(Design code. *PtD specific.*)

So how are we doing now that we're so advanced?

Beyond disasters - a Parallel Worker Focus

- In the early 90's practitioners noted that
  - Design safety was **not well covered in literature**,
  - Was **seldom found in management guides**,
  - And was **usually not a corrective action** in incident investigations.

- Yet, **more than one third** of accident investigations listed **DESIGN as a cause**.

Moses 1.0 beats “must trust”

Courtesy of TJ Lyons, Gilbane Federal

WORKING SAFER BY DESIGN

Avoiding the “must trust” Design Options

Design in the Prevention

2015: Best PtD ELIMINATES fall hazard (Parapet at a different facility)*

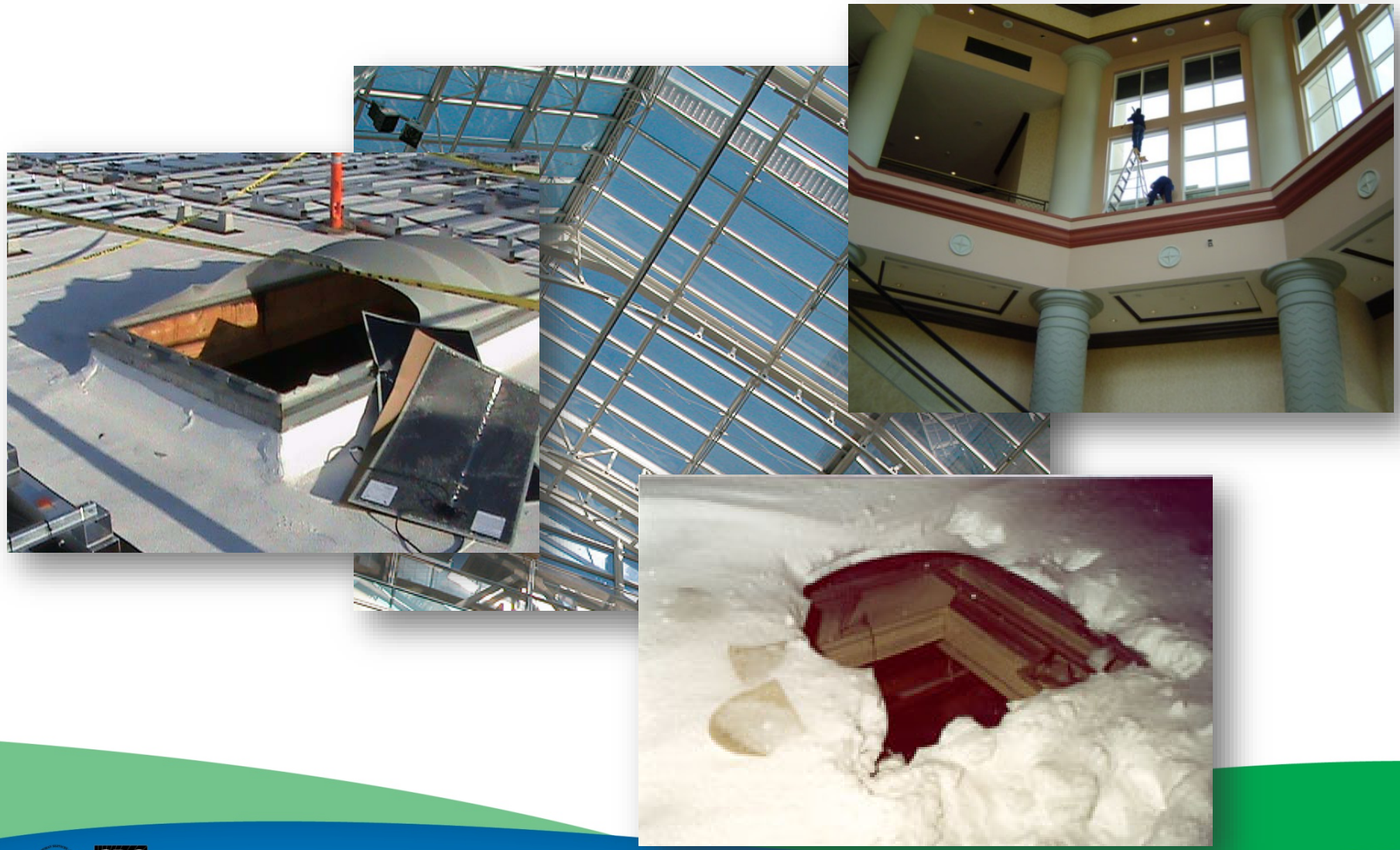
2015: PtD, but still relies on PPE or “must trust” (new hospital wing)*

1940/50: NO fall protection & later HVAC placed near edge (old hospital wing)*

11

* Explanatory notes added by J. Bach, NIOSH

“Green” Tech … Skylights, Atria Windows



"Green" Tech … think *LifeCycle* Safety

Moses 1.0?

SAFE Sustainability

Have you heard of LEED® certified "Green" buildings?

SAFE Sustainability in 2009?

www.mgmresorts.com/csr/environmental/green-advantage/green-building.aspx

SIX LEED® Gold Certifications in 2009

"CityCenter, the largest sustainable development in the world … received 6 LEED Gold Awards from the US Green Building Council."

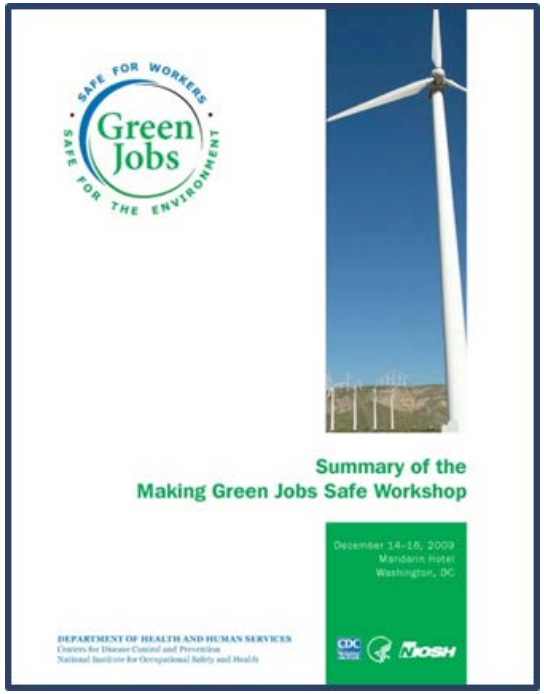
A Bittersweet Accomplishment …

SIX Construction Deaths in 2007-2008

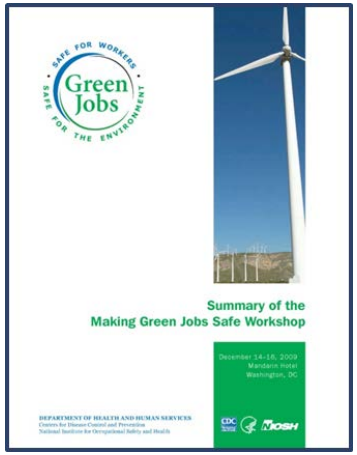
The U.S. Green Building Council (USGBC) joined with NIOSH to investigate "LifeCycle Safety" in Sustainability – to include ALL occupants including those at Construction phase and later O&M.

Green, *Sustainable* - but not SAFE?

- **Sustainable?** Green designers save energy & resources and reduce pollution (and also include indoor air quality for final *occupants*)
- **Occupants?** Green designers may not think of *construction workers* or *operations and maintenance workers* as "occupants" during the entire *Life Cycle* of the endeavor
- **Safe?** Green designers *may not be skilled in worker hazard recognition or prevention*
- **How "Sustainable" is *dangerous* technology?**



SAFE Sustainability is gaining ground …



- **ASCE Code of Ethics …**

  … "Sustainable Development … to enhance the safety, welfare, and quality of life for all of society while maintaining … natural resources."

Green + LifeCycle Safety

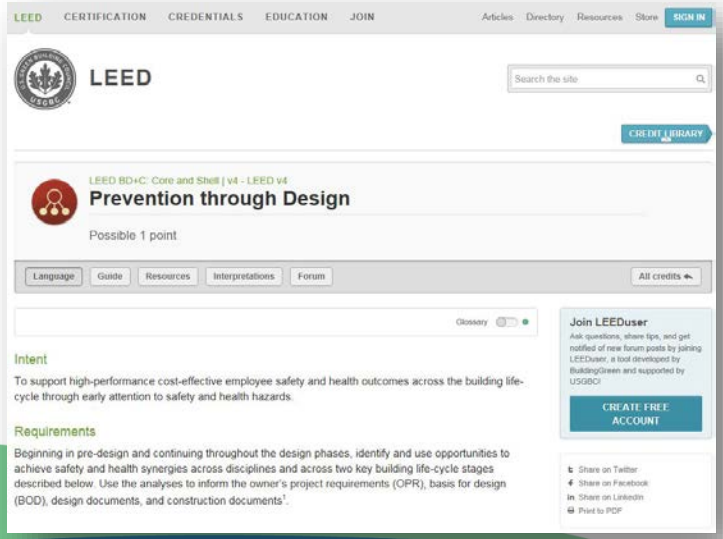
= Socially Responsible Sustainability

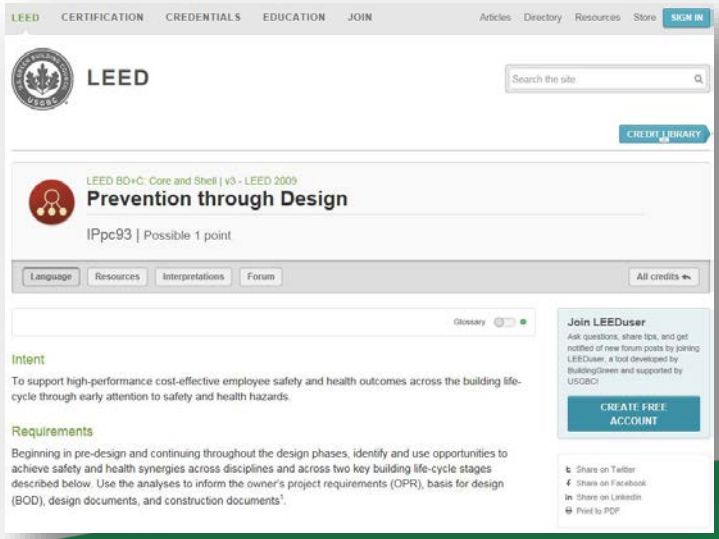
BIG Policy Advance in Green Building!

- In February 2015, the U.S. Green Building Council published PtD credits for the Leadership in Energy and Environmental Design (LEED) rating system.

www.usgbc.org/credits/preventionthroughdesign

www.usgbc.org/credits/preventionthroughdesign2009





www.osha.gov/sustainability

UNITED STATES DEPARTMENT OF LABOR

Find it in OSHA

A TO Z INDEX

Occupational Safety and Health Administration

English | Spanish

ABOUT OSHA | WORKERS | EMPLOYERS | REGULATIONS | ENFORCEMENT | TOPICS | NEWS | DATA | TRAINING

Sustainability in the Workplace

- HOME
- OSH-Sustainability Connection
- Sustainability Spotlight
- Contact Us

Sustainable organizations strive to balance the triple bottom line of people, planet, and profit to achieve long-term success and viability. This means that organizations cannot be sustainable without protecting the safety, health, and welfare of their most vital resource: workers. Sustainability is not just about what is done, but how it gets done. It is a mindset that requires leadership; not settling for second best in any aspect of operations; setting and achieving goals beyond regulatory compliance.

Organizations of all sizes across the country and around the world have embraced this mindset as a way to showcase their values, measure impacts and outcomes, and increase their competitive advantage. However, workplace safety and health is often underemphasized, or overlooked completely. Integrating safety and health into sustainability provides an opportunity to better protect workers and achieve a truly sustainable organization.

Learn more about the connection between occupational safety and health and sustainability here.

Latest from OSHA

Sustainability White Paper Released

Sustainability Spotlight

Center for Safety & Health Sustainability

CSHS provides over 100,000 occupational safety and health professionals in over 70 countries with a stronger voice in shaping sustainability policies.

Officially launched in 2011, the Center for Safety & Health Sustainability, a joint effort of safety and health professional organizations in the US, Canada, and the UK, is driven by the strong belief that an organization cannot be sustainable if it does not ensure safe and healthful conditions for its workers and contractors. [...]

Read More

Agenda

- **PtD & the National Initiative** – *Burden, Need, Impact*
- **Policy History and Current Trends**
- **How to *Change* your *Culture* to *Prevention***
  - **Culture still NEEDS to Change**
- **What do you do next?**
- **SO What ?**

Culture still NEEDS to Change

Safety and Health is
confused with reliability

Safety and Health is
compartmentalized

PtD is NOT Reliability Engineering

- PROBLEM: For many, Reliability Engineering replaces System Safety or PtD

- Assumption: If it's reliable, it's safe. Focusing on "failures" in accident analysis seems to show this.
- Reality: Reliable systems can be unsafe. Reliability and Safety are different properties.
- Example …

Reliability ≠ Safety

Accidents where no components fail

Batch Chemical Reactor in England

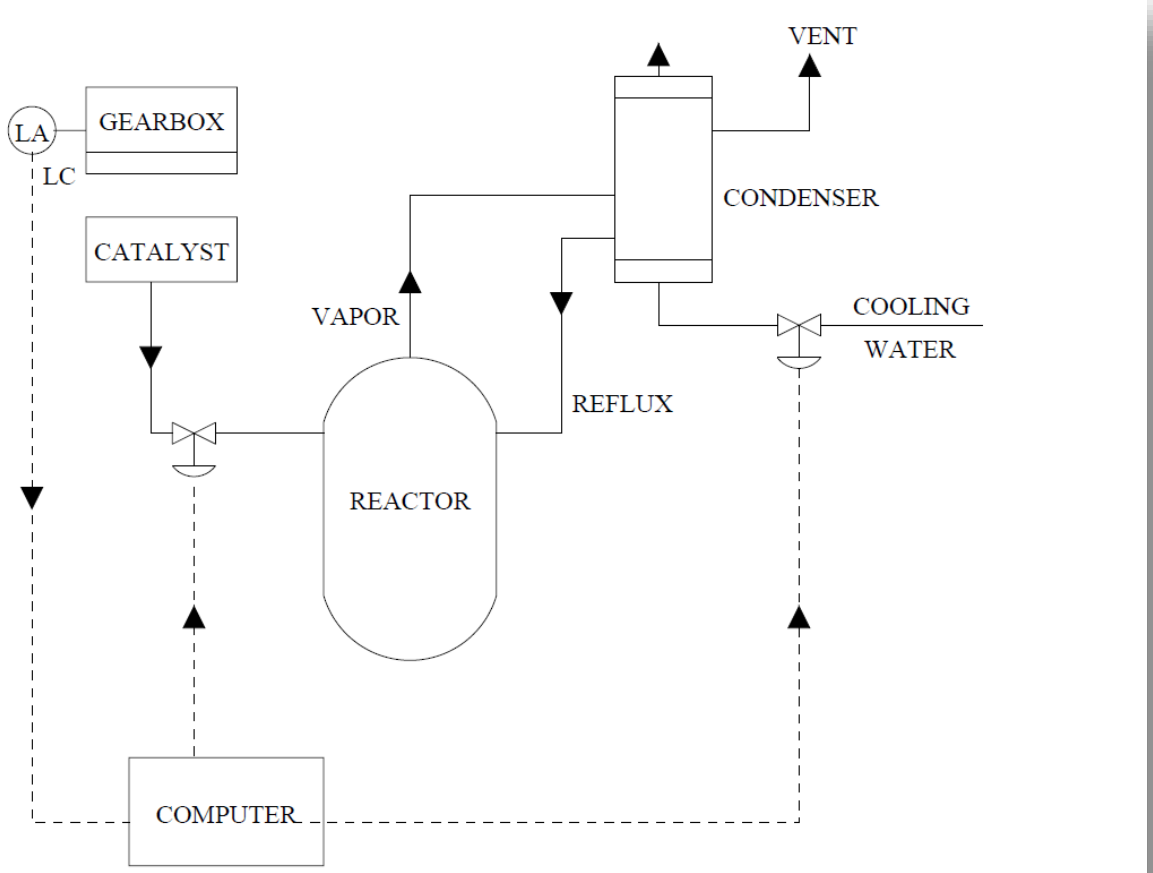


Figure 1: A chemical reactor design. (Source: Trevor Kletz, Human problems with computer control, *Plant/Operations Progress*, 1(4), October 1982. page 6.

Safety & Health Compartmentalized …

An Example from "Deepwater Horizon"

PSM isn't working well enough

Large, avoidable, chemical incidents continue in the U.S.

- 17 Apr 2013: Fertilizer Facility, West, TX. NH4NO3. 15 die, 160 injured
- 1 Aug 2013: Executive Order *Improving Chemical Facility Safety and Security*
- 2 Dec 2014: The CSB releases a video on the 30th anniversary of Bhopal (6 minutes): www.csb.gov/videos or www.youtube.com/watch?v=HZirRB32qzU
- The CSB says that the PSM regulations are in need of reform, emphasizing ***"Prevention through Safer Design"***

Personnel Safety Burden is HIGH

- The U.S. oil and gas extraction industry (onshore + offshore) had a **fatality rate seven times higher than for all U.S. workers** (27.1 versus 3.8 deaths per 100,000 workers) during 2003–2010.

  - Transportation events were the leading cause of fatalities (65 [51%] with 49 being helicopter related), followed by contact with objects or equipment (21 [16%]), fires and explosions (17 [13%]), and exposure to harmful substances/environments (16 [13%]).

Fatal Injuries in Offshore Oil and Gas Operations — United States, 2003–2010.
www.cdc.gov/mmwr/preview/mmwrhtml/mm6216a2.htm

Process and Personnel Safety?
Process vs Personnel Safety?

Personnel Safety and Process Safety are often treated separately.

Bhopal: Personnel Safety and Process Safety was poor.
An underlying poor Safety Culture *appears* to be a cause.

Deepwater Horizon: *Personnel* Safety *appeared* high (awards just prior to well blowout). Safety Culture looked good on the "surface" (by simple measures).

Yet adherence to Process Safety controls and preventive maintenance was compromised, and dozens of *personnel* were killed or injured – with thousands more put at risk during the cleanup.

If Corporate Safety Culture was **REAL**, or "deep," wouldn't **both** Personnel **and** Process Safety be solid?

One "Safety Culture" or TWO ?

- Is "Personnel Safety" the job of the **OSH** office, "Process Safety" the job of engineering, with low collaboration? (*PSM is **OSH**A!*)
- Is "good" personnel safety masking process safety issues – leading to a **false sense of security**? (vice versa?)
- Are end users/operators brought into design review for Personnel Safety/Health? (legally-required for Process Safety)
- Is the Safety Culture "surface" (tacked on, not integrated) – and everyone knows it?

CAN Process Safety *BE* PtD?

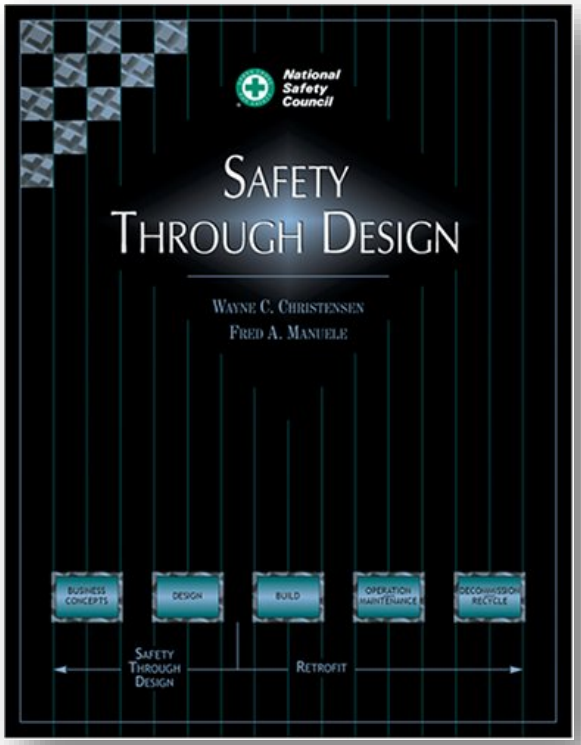
- It already is PtD, yet the same methods are not always applied to the full variety of worker hazards.
- Designs to avoid loss of containment episodes require specialized expertise, yet those same experts may not "see" the full range of other worker hazards.
- If OSH experts and key workers are brought in for periodic Design Safety Reviews, they can provide the expertise needed to address *all* worker hazards.
- The preference in either case is inherent safety. Adding "safety systems" is not needed when a hazard is gone.

Safety = Process + Personnel

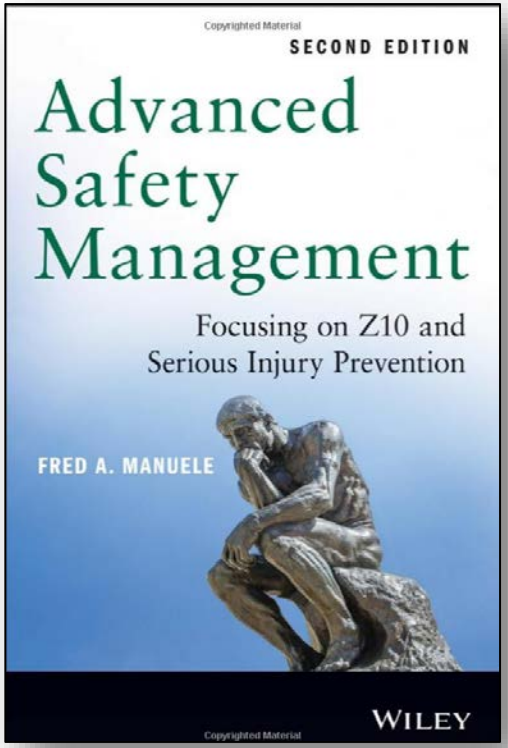
IDEAS to *integrate* Personnel *with* Process Safety …

- Top management requires (and receives reports verifying):
  - That ***Process*** Designs/Re-designs/Retrofits include PtD ***Personnel*** *Hazard* Design Safety Reviews (DSR) (during Hazard Identification, Risk Assessment, Alternatives Identification, Alternatives Assessment).
  - That DSR team membership include experienced, knowledgeable End-Users/Operators & Safety/Health personnel *along with* the normal designers.
  - The DSR to provide their lists of hazards, alternatives, and recommendations.

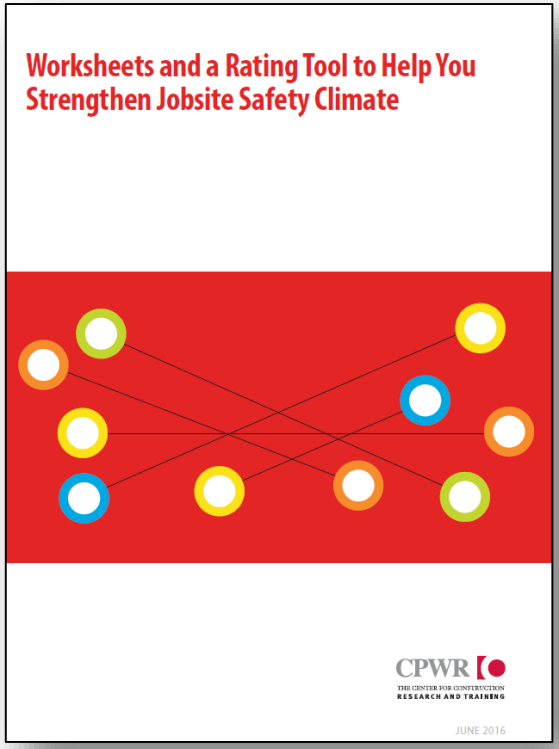
Culture Change … how to DO it



See Chapter 4

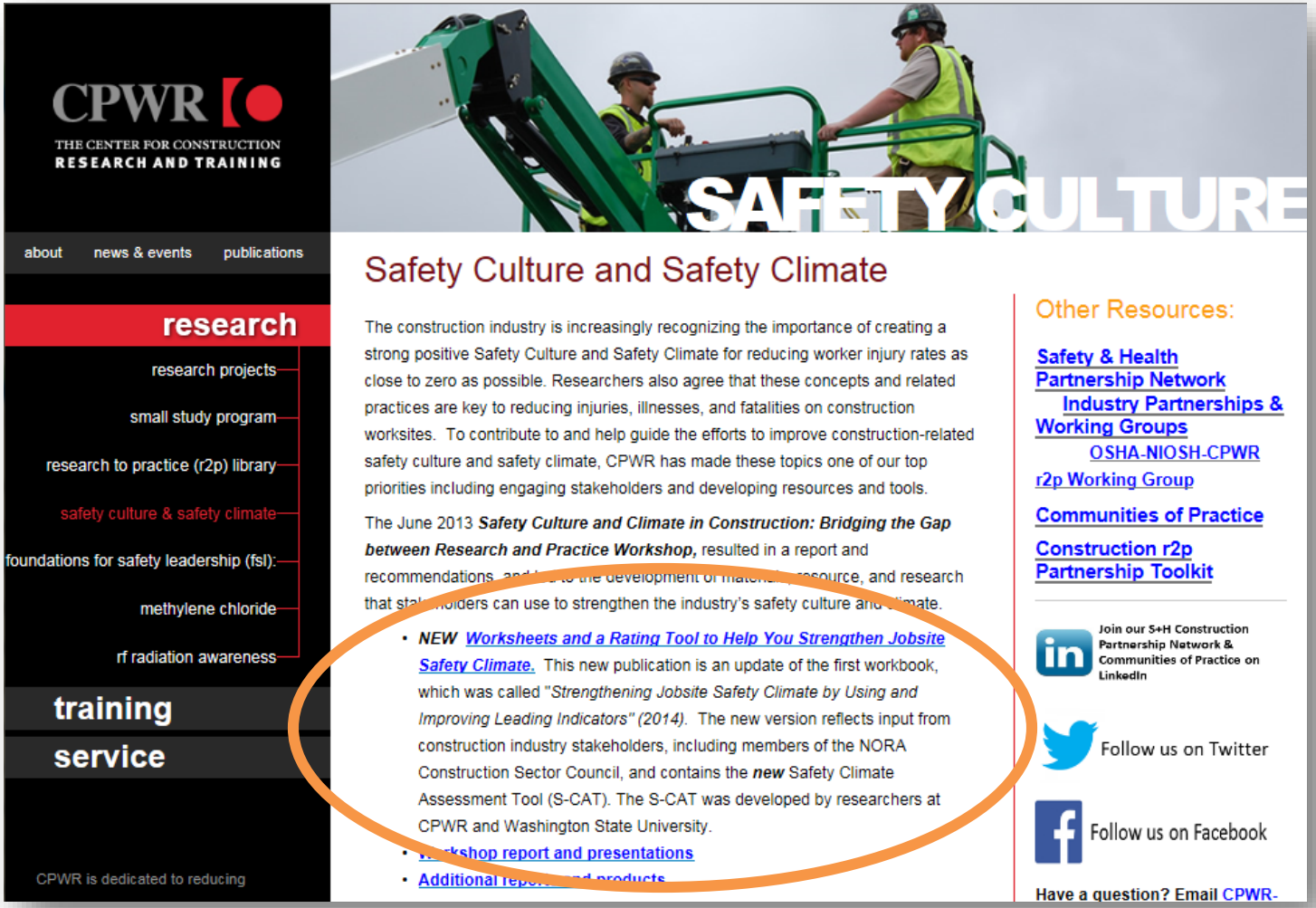


See Chapter 6



www.cpwr.com/safety-culture

What's your Safety Culture *Rating*?



www.cpwr.com/safety-culture

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- **What do you do next?**
- **SO What ?**

Real Examples and Savings …

Working Safer by Design

Presented By:

TJ Lyons CSP CRIS

Construction Safety Manager

Gilbane Federal

Good: Protect the Receiver …

WORKING SAFER BY DESIGN

PtD During Construction

Conventional pedestrian protection (rooftop mechanical upgrades – NYC)

16

Courtesy of TJ Lyons, Gilbane Federal

Better: Stop it at the Source !

WORKING SAFER BY DESIGN

PtD During Construction
Must Answer "What's in this for me?"

Rooftop barrier instead –
1/3 the cost (six figures) ☑

17

Courtesy of TJ Lyons, Gilbane Federal

Design moves costs up front …

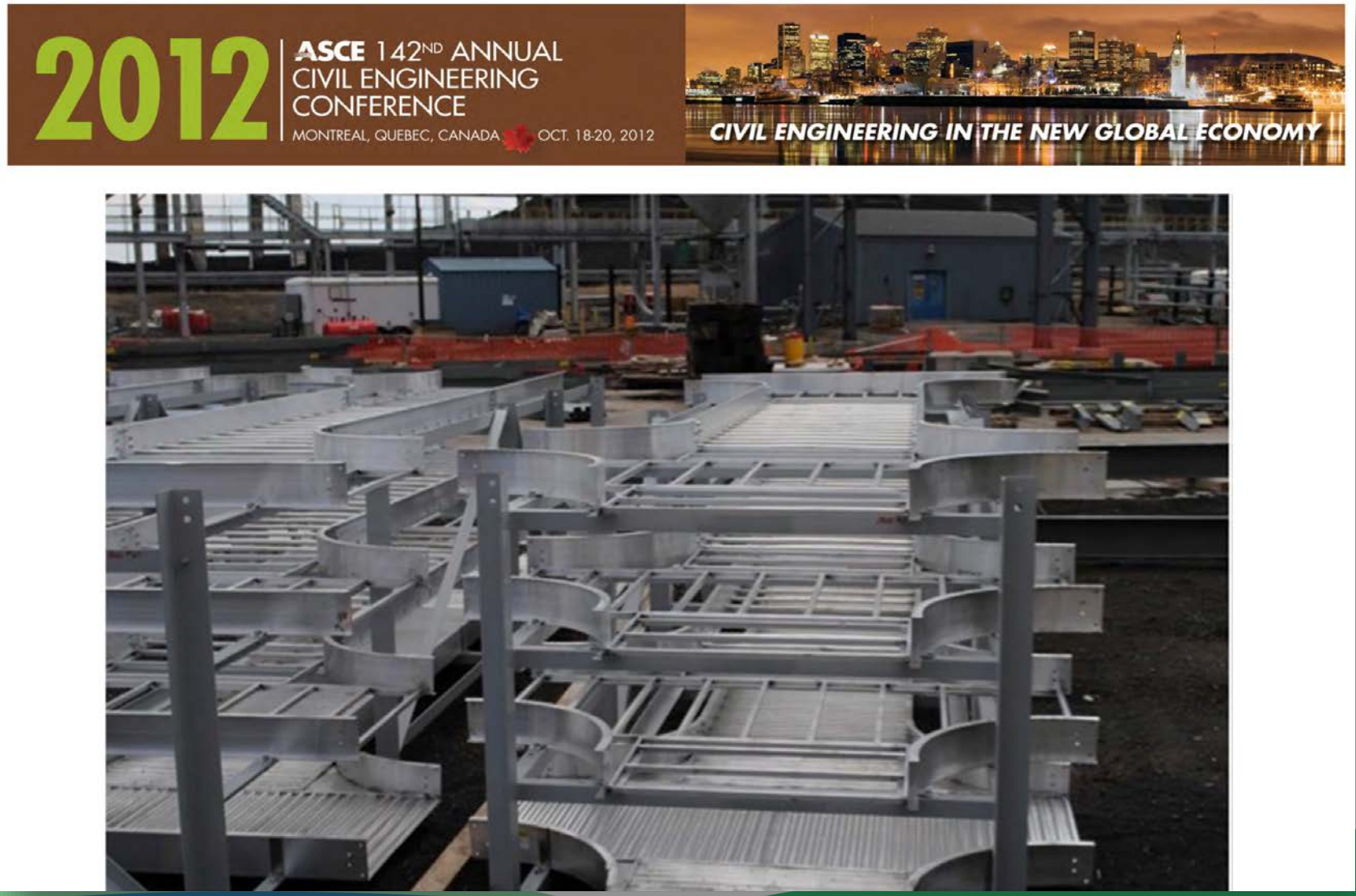
THE GLOBAL GROWTH OF PREVENTION THROUGH DESIGN

Bradley Giles, P.E., CSP, STS
Vice President – ESH&S, URS Corporation

Difficult work in tight spaces …

Conventional tray support system (all supports are hand assembled in the field.

Re-design: Modular, Pre-fab …



Planning: Prefab unit installed

Cable tray bundle being lifted into Absorber building Unit 1 by electricians and ironworks (timing correct – no overhead steel)

Move LOWER costs up FRONT!

Cost category	Preassembly	Stick build	Savings
Craft hours	1,300	7,910	6,610
Craft related costs	$79,812	$477,391	$397,579
Material and assembly costs	$142,408	$132,389	($10,019)
Engineering hours	743 (required to develop design of modules)	0 (original design based on typical details from previous project)	(743)
Engineering costs	$92,291	0	($92,291)
Total costs	**$314,511**	**$609,780**	**$295,269**

The above represents a 48% total savings and a 83% installation savings. Opportunities for future savings will be by the elimination of the added engineering costs by standardizing this method of supporting cable tray in long runs of vertically stacked tray and stacked tray in concentrated areas.

The constructability approach is being applied to 75% of project applications, duct work, cable trays, piping, handrail, stairwells, etc. The project has worked since August 2008 1.8 million safe work hours without a days away case.

Prefabrication, Modularity

Modular Service Risers

Dr. Mike Toole,
www.DesignForConstructionSafety.org

Inherently Safer Chemical Process Design

- Intensify/Minimize
  - Reduce inventories of hazardous materials
- Substitute/Eliminate
  - Use less hazardous materials
- Attenuate/Moderate
  - Reduce severity of conditions by using a better cataly
- Limit Effects
  - Transport in less hazardous form, via safer methods, via safer routes
- Simplify
  - Simplify material handling

Photo courtesy of Thinkstock

[Hendershot 2011]

Intensify/minimize the Reaction

- Minimize feedstocks
- Minimize reactor size
- Dilute catalyst
- Use automatic feed controls
- Minimize pipe runs
- Minimize pipe diameter
- Process options
- Equipment options
- Chemical phase
- Minimize fugitive emissions

Substitute/eliminate

- Substitute/eliminate
  - Optimize catalyst selection (for maximum conversion)
  - Optimize suspension agent (to ensure dispersion)
  - Consider fluid with higher heat capacity than water (to minimize volume needed for bath); or fluidized bed reactor
  - Use external jacket rather than internal coils for heat transfer (to prevent contamination by heat transfer fluid)
  - Use high grade metals, or line reactor and storage tanks to prevent contamination from corrosion

Attenuation/moderation

- Operate at temperature and pressure as close to ambient as possible
- Construct reactor to handle maximum potential emergency pressure
- Have redundant sensors (e.g., temperature and pressure) tied to automatic feed shutoff
- Build within enclosure to contain leaks, explosions; double-walled tanks

Attenuation/moderation (cont.)

- Build a “dump tank” area with a diluent or short-stopping agent to receive reactor contents in event of emergency
- Provide for manual addition of diluent or short-stopping agent directly into reactor in emergencies
- Provide insulation to prevent external heat from causing runaway reaction
- Optimize design of pressure relief system

Limit effects

- Have aggressive leak detection and repair program
- Redundant controls to prevent runaway reactions/over-pressurization
- Provide controls to prevent reverse flow during overpressure situations:
  - For example, back into the feed storage tanks,
  - Through check valves,
  - Positive displacement pumps, or
  - By elevating feed tanks above reactor with pressure relief device on feed line

Simplify

- Reduce drying and packaging equipment
- Carefully check packaging lines for pinch points and other hazards
- Ensure control-room displays are intuitive
- Fail-safe controls
- Minimize pipe bends, seams, joints, valves (balance with minimizing mass within pipe segments)
- Train workers frequently to make safe behavior automatic

Inherently Safer Chemical Process Design

John Warner presentation on ecomaterials

Link: vimeo.com/20060171

He discusses…

- New era of chemical engineering
- Responsibility of chemists for health and safety from design to product
- Need for toxicology education in university coursework
- Prioritizing sustainability in chemical engineering (both in process and end application)
- Reduction of chemical waste by improving process
- Enthalpic vs Entropic approaches

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PSM & Collaborative Design

- Regulatory standard applicable to work with highly hazardous chemicals 29 CFR 1910.119
- Major sections include:
  - Process safety information
  - Process hazard analysis and pre-startup safety reviews
  - Operating procedures
  - Employee involvement and training
  - Contractor oversight
  - Mechanical Integrity
  - Management of change
  - Incident investigation
  - Emergency planning and response

Collaborative Design Advantage …

Several advantages of collaborative, multi-disciplinary teams …

Collaborative Design Advantage …

Will ensure you have the legal and technical know-how

Collaborative Design Advantage …

Will ensure you have end user and operator experience, preferences, and lessons-learned

Collaborative Design Advantage …

Will ensure you reach consensus on important issues

Collaborative Design Advantage …

Will do a better job managing change

Collaborative Design Advantage …

Will help ensure follow-through

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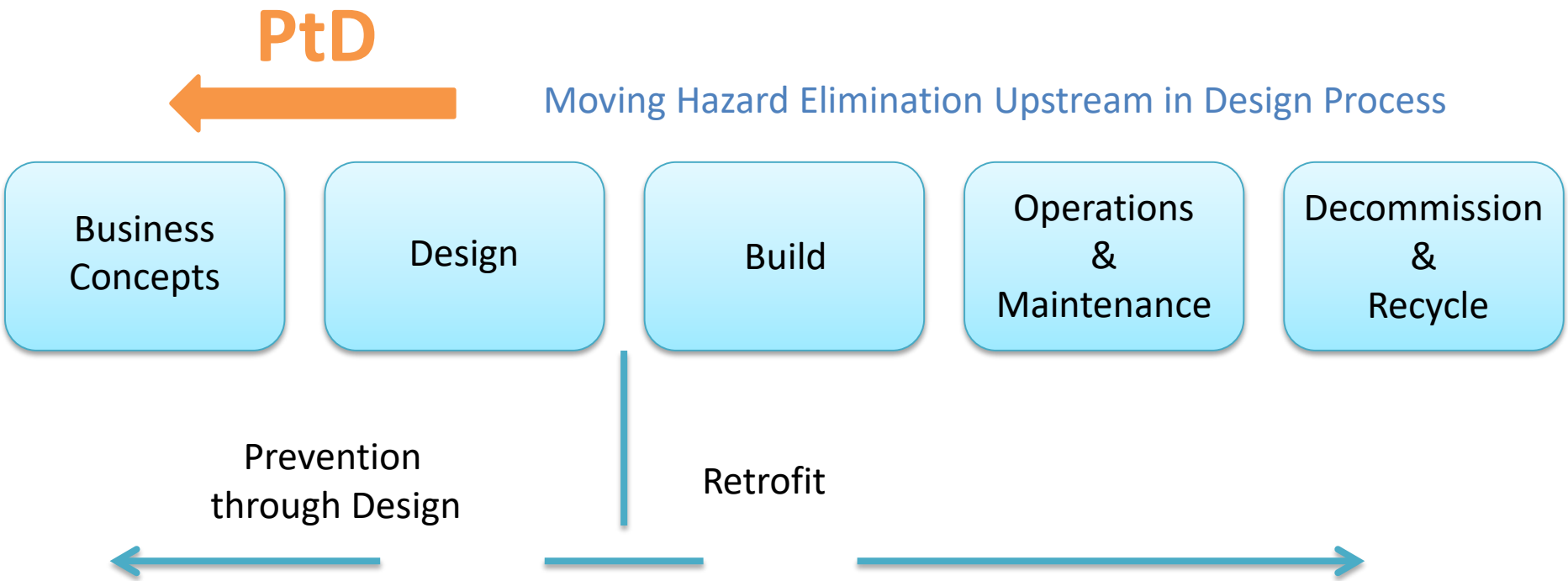
Process Safety Mgt & PtD Process

- Regulatory standard applicable to work with highly hazardous chemicals 29 CFR 1910.119
- Major sections include:
  - Process safety information
  - Process hazard analysis and pre-startup safety reviews
  - Operating procedures
  - Employee involvement and training
  - Contractor oversight
  - Mechanical Integrity
  - Management of change
  - Incident investigation
  - Emergency planning and response

Walking through a Simple Example …



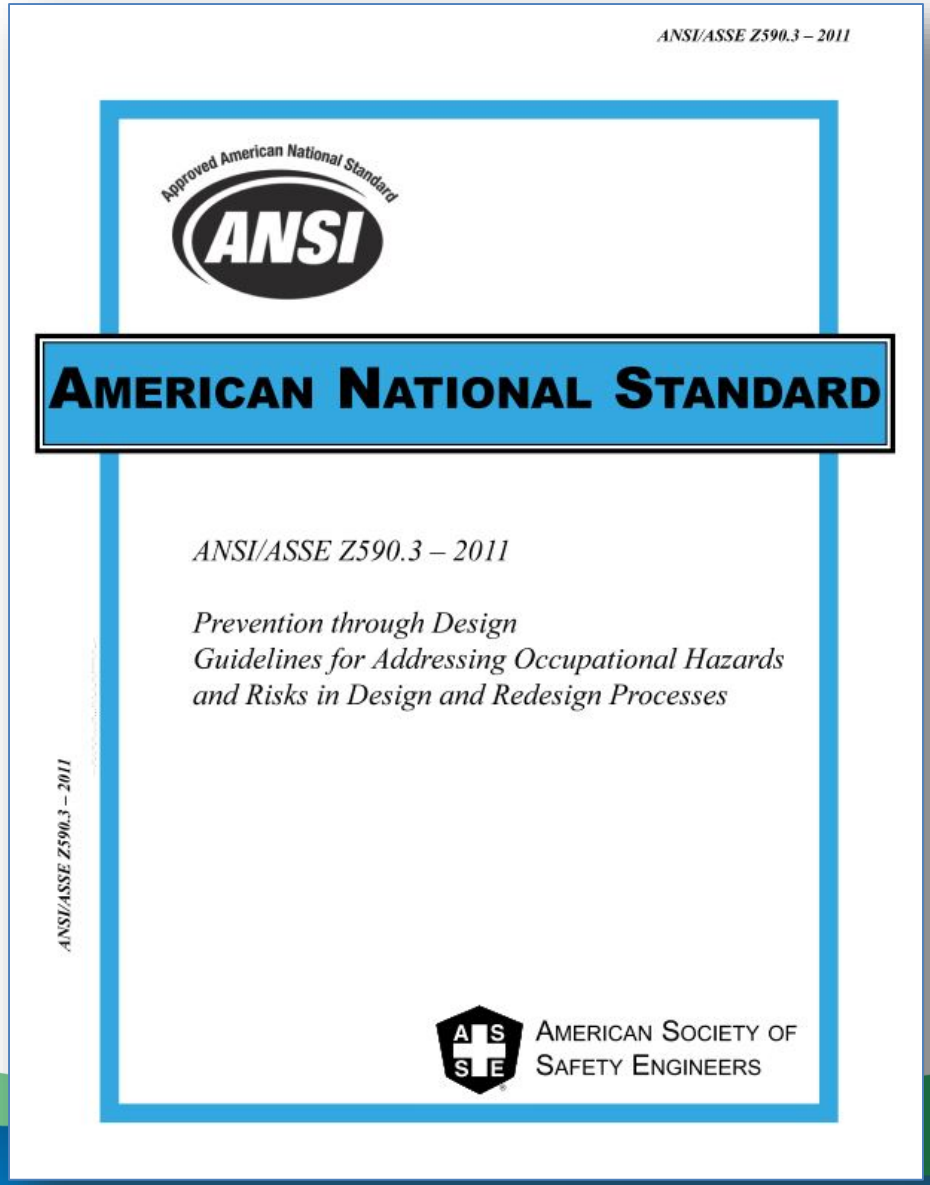
To move worker protection from an afterthought to a forethought in process, product and facility design

2nd - the PROCESS

Walking through a Simple Example …

Purchase the ANSI/ASSE z590.3 PtD Standard!

If you already have a Process/Systems Safety Design Safety review system, make sure it includes **worker hazard protection as an equal priority**



If you need a System, follow the z590.3

It is "Systems Safety Light"

It is GENERAL, SHORT (but with helpful appendices), and is a safety review PROCESS for any type of business

Int'l System Safety Society & MIL-STD-882E

The International System Safety Society
Professionals Dedicated to the Safety of Systems, Products and Services

1962 The International 50 System Safety Society 2012

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Organized 1962
Incorporated 1973

- About the Society
- Journal of System Safety
- Chapters
- Conferences
- Products and Resources
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- Employment Opportunities
- System Safety Links
- Tech Fellows

Vision Statement

To make the world a safer place through safer systems.

Mission Statement

Advance the system safety discipline by creating an international, interdependent network of system safety professionals dedicated to the continuous improvement of the art, sciences and technology needed to provide the best total system safety solutions. Be the recognized international leader in the system safety discipline.

Welcome

The International System Safety Society is a non-profit organization supporting safety professionals worldwide. With a wide range of individual and corporate members, the Society is affiliated with major corporations, educational

Journal of System Safety

About the Journal

Journal of System Safety is the official publication of the System Safety Society and is the leading source of cutting-edge information about the latest developments in the system safety field.

Find out more -»

Notice of the Reduction in the Number of *Journal of System Safety* Society Issues

The finances of the society were hurt by the government sequestration. In the past, conference income amounted to over half of our total income and the loss of this income for last year combined with the anticipated reduction in conference income for future years has caused the executive council of the society to aggressively cut costs. One of the many areas we have had to cut back in is the number of publications per year of the Journal of System Safety (JSS). This decision was not reached

Conference Info

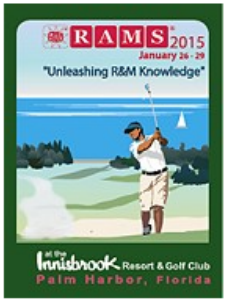
The 33rd International System Safety Conference

August 24–28, 2015
Manchester Grand Hyatt San Diego, San Diego California

The 32nd International System Safety Training Symposium

Bulletin Board

RAMS 2015



www.rams.org

GLOBESPACE 2014

The symposium date has been rescheduled to December 1-4, 2014.

Download the Call for Papers in PDF

download newsletter.

MIL-STD-882E

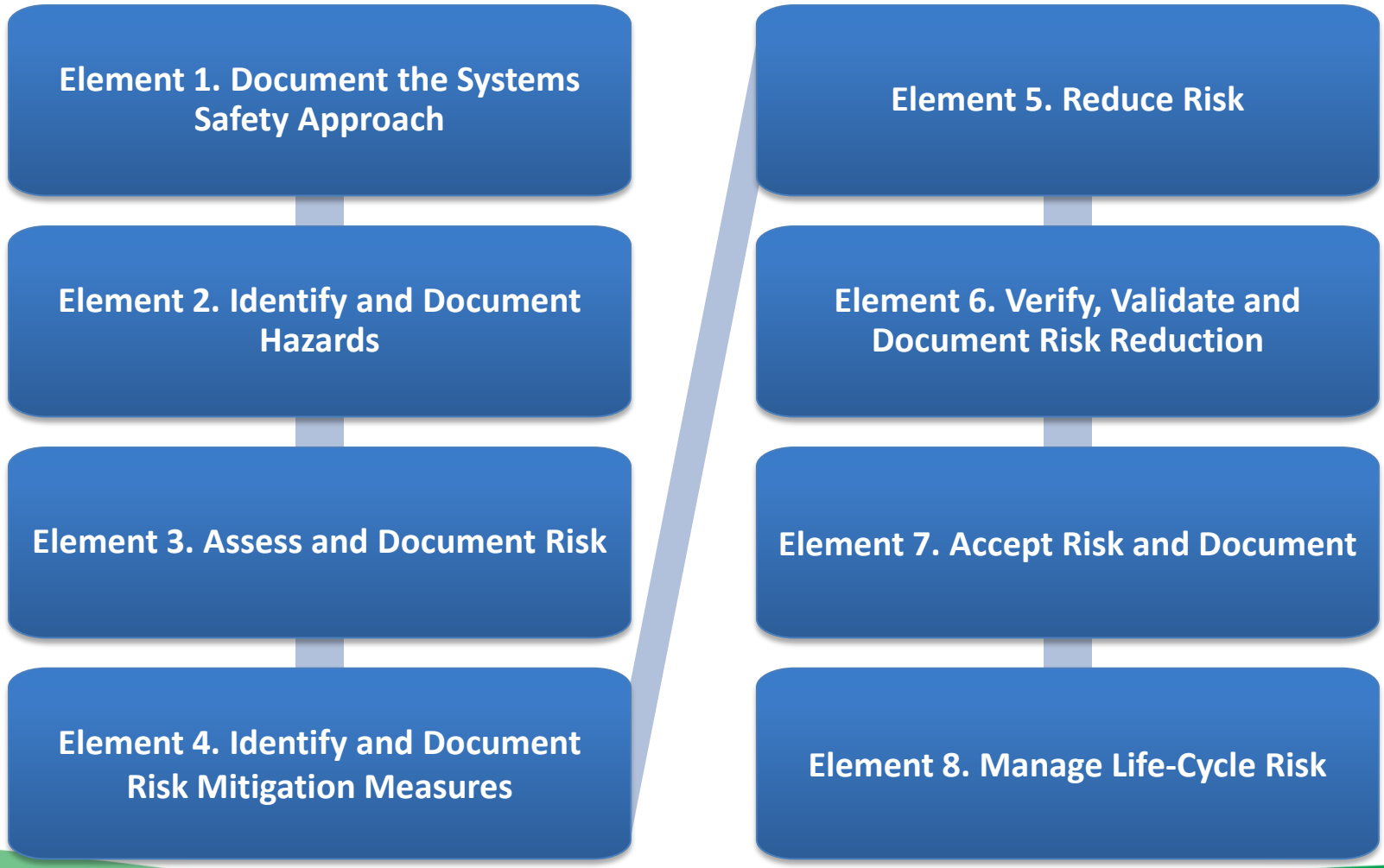
MIL-STD-882E officially released on 11May2012.

Click here for a copy

CDC Workplace Safety and Health NIOSH

www.system-safety.org

The Systems Safety Process (MIL STD 882E)



Making Design Safety Reviews work

Buy the ANSI/ASSE z590.3 PtD standard, it is loaded with helpful guidance in a very short space, then expands on that with many helpful appendices. For example, though summarized and annotated for this slide, the z590.3 provides guidance on running Design Safety Review meetings:

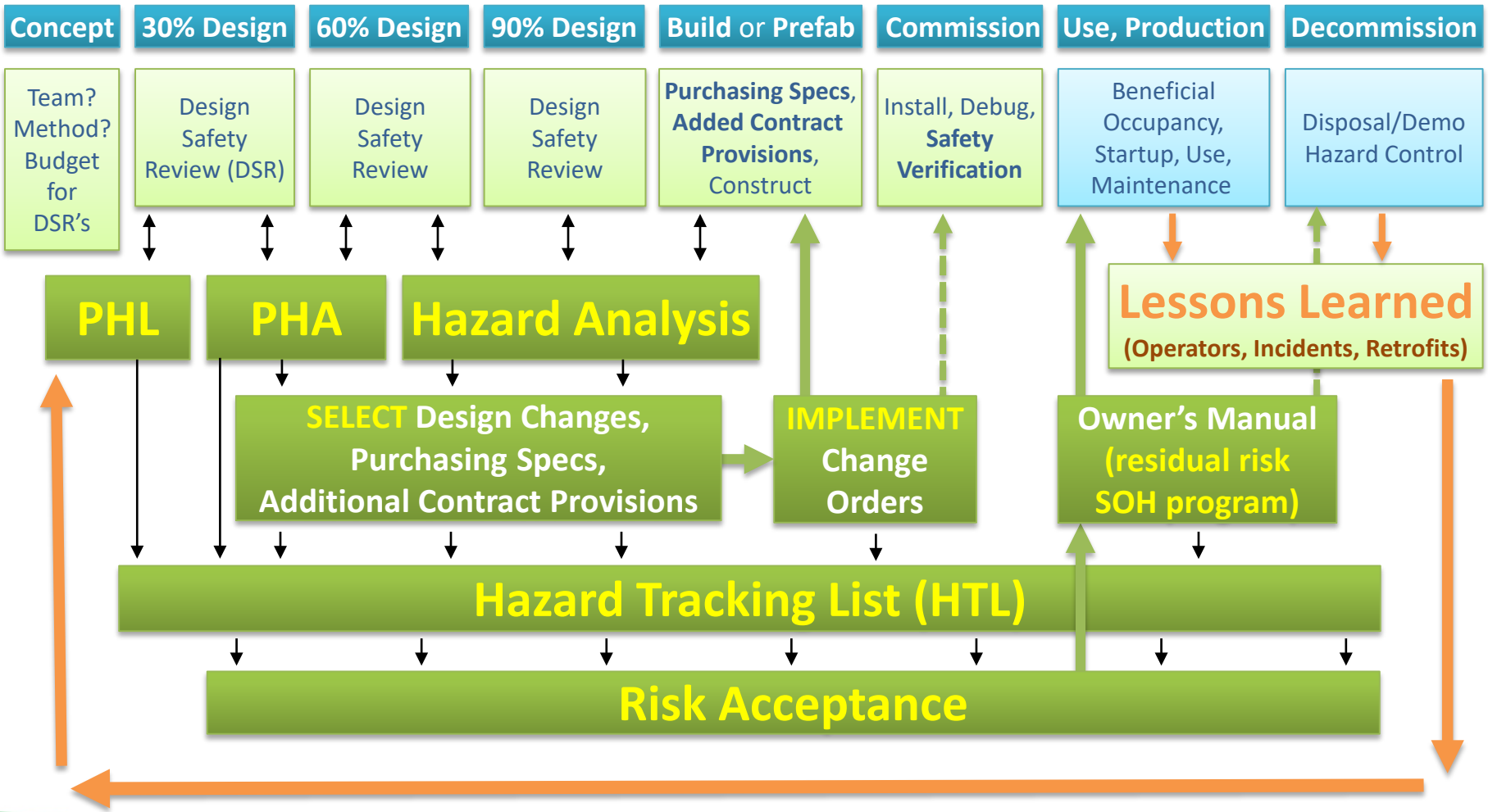
Typical design safety review, DSR, meeting :

1. The project leader distributes drawings and checklists *(you need to prep those earlier).*
2. The team chooses a facilitator, often a disinterested designer not assigned to or intimately familiar with the project.
3. The project leader describes the project and answers questions.
4. The project leader, or assistant, updates documentation, e.g. design punch list, hazard tracking tables *(method not fixed in stone – use what works for your company and team. Documentation examples to follow come from the Army and the MIL STD 882, e.g. hazard lists in a table).*
5. Facilitator leads a methodical review using a generic checklist, with team members asking detailed questions to ensure thorough consideration of hazards and their control. Checklist items and sections that are not applicable are so noted. *(brainstorming happens here)*
6. Additional discipline checklists are reviewed as appropriate.
7. Keep and have everyone sign the marked up copy of the checklists.

The PtD Process in a Business LifeCycle

- The following Process diagram illustrates key points
- It is not a real business's example, but a mixture of various diagrams and terms - for concepts
- The reference to 30, 60 and 90% design points comes from construction and is NOT an official PtD "rule"
- Do the design reviews at the best points for your business and your process …

The PtD Process in a Project LifeCycle



Checklist + Multidiscipline Brainstorming

USE Checklists of common design issues.

(e.g. *Advanced Safety Management*, Fred Manuele)

Design team members with similar system experience provide inputs from LESSONS LEARNED.

[Checklist courtesy of John Gambatese]

Item	Description
1.0	**Structural Framing**
1.1	Space slab and mat foundation top reinforcing steel at no more than 6 inches on center each way to provide a safe walking surface.
1.2	Design floor perimeter beams and beams above floor openings to support lanyards.
1.3	Design steel columns with holes at 21 and 42 inches above the floor level to support guardrail cables.
2.0	**Accessibility**
2.1	Provide adequate access to all valves and controls.
2.2	Orient equipment and controls so that they do not obstruct walkways and work areas.
2.3	Locate shutoff valves and switches in sight of the equipment which they control.
2.4	Provide adequate head room for access to equipment, electrical panels, and storage areas.
2.5	Design welded connections such that the weld locations can be safely accessed.

Checklist + Multidiscipline Brainstorming

Prevention through Design

Design for Construction Safety

Home | Concept | Process | History & Future | Challenges | Resources | Links | Contacts

A very thorough Bibliography compiled by Dr. Nicholas Tymvios (updated June 12, 2016)

Design Tools www.designforconstructionsafety.org/media.shtml

SliDeRulE (Safety in Design Risk Evaluator) assists building designers with assessing the construction safety risk associated with their designs.

Safe Design Guidelines distributed by the San Francisco Public Utilities Commission.

1600+ PtD list compiled by Alan Speegle (The Southern Company). Note: This spreadsheet is most helpful for process (i.e., industrial) construction. The attached file was posted 12/14/11. Please discard the previous version posted.

Researchers and practitioners have created The Sustainable Construction Safety and Health (SCSH) rating system to evaluate construction worker safety and health on construction projects.

OSHA's hazard identification training tool may prove helpful for education design engineers and other non-safety professionals about common construction site hazards.

Workplace Design Solutions developed by NIOSH

Preventing Falls from Heights through the Design of Embedded Safety Features

Preventing Falls through the Design of Roof Parapets

Construction Workplace Design Solutions

developed by the OSHA Alliance Program's Construction Roundtable

Falls From Roof Edge

Risk Assessment Code (RAC) Matrix …

Example from MIL STD 882

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			

Documenting Design Safety Reviews

- Do what works best for your company and your team
- The examples of hazard lists on the following slides are from the MIL STD 882 and the Army Corps of Engineers, e.g. Preliminary Hazard List (PHL), Preliminary Hazard Analysis (PHA), and Hazard Tracking List (HTL)
- You'll need to create your own punch lists or tables if only to avoid conflicting acronyms! (*e.g. PHA means something different in Chemical Process Safety*)

PHL - Preliminary Hazard List

PHL - PRELIMINARY HAZARD LIST					
Hazard ID	**Hazardous Element**	**Causal Factor**	**Effect**	**RAC**	**Remarks**
1.1	Roof Falls from roof while cleaning or maintaining skylights	Roof pitch or weather conditions cause workers to lose footing	Death from falls	1	
1.2	Interior ceiling and electrical Falls from man lift or storage shelves while changing light bulbs	Inability to access light bulbs over storage racks with man lift	Death from falls.	1	Mitigation may also reduce maintenance manpower requirements

PHA - Preliminary Hazard Analysis

PHA – PRELIMINARY HAZARD ANALYSIS								
Hazard Source	System	Causal Factors	Effects	RAC	Comments	Recommended Actions	Control RAC	Standards
Falls from roof while cleaning or maintaining skylights	Roof	Roof pitch or weather conditions cause workers to lose footing	Death from falls	IC High		Fixed exterior ladder. Tie-off points for work performed on roof.	ID High	OSHA
Falls from man lift or storage shelves while changing light bulbs	Interior ceiling and electrical	Inability to access light bulbs over storage racks with man lift	Death from falls	ID High	Mitigation may also reduce maintenance manpower requirements	Suspend fixtures to make them accessible to man lifts in building. Position fixtures so they are not blocked by shelving (consult customer for shelving requirements)	IE Medium	OSHA

HTL - Hazard Tracking List

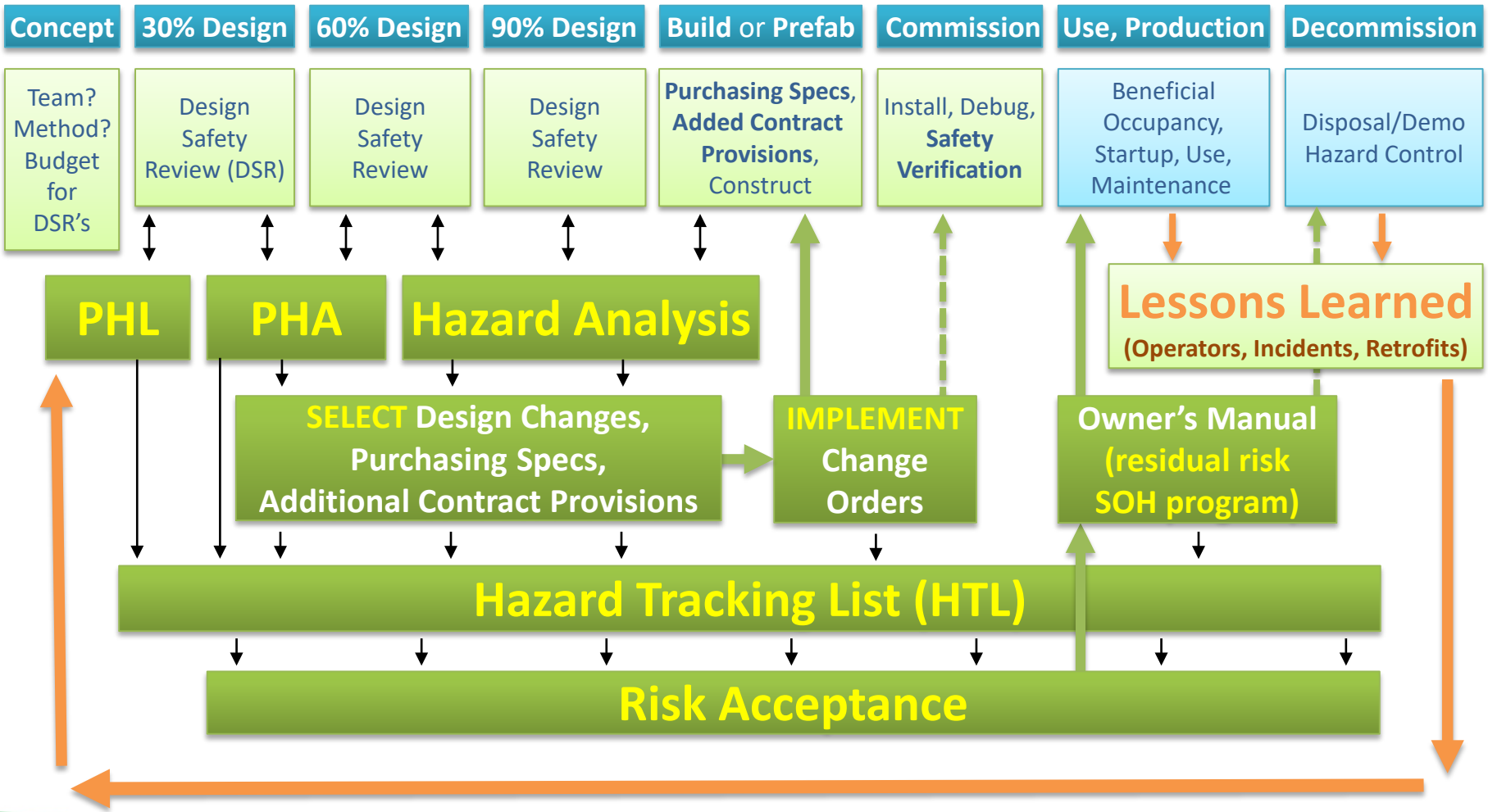
HTL – HAZARD TRACKING LIST							
Risk	**Hazard**	**Cause**	**Design Process element affected**	**Impact on Project Objectives**	**Risk Manager**	**Agreed Response to Risk**	**Expected Resulting Risk**
HIGH	Falls from roof while cleaning or maintaining skylights	Roof pitch or weather conditions	(whatever makes sense for your design methods)	Cost, Schedule Slippage	Designer, Const. Mgr, Constructor	Fixed exterior ladder. Tie-off points for work performed on roof.	LOW
HIGH	Harm from chemicals	Exposure to chemicals	Investigative, Construction	Cost, Schedule Slippage	Designer, Const. Mgr, Constructor	Add HTRW CEGS to Design Specifications	LOW

A Reminder from Three Mile Island

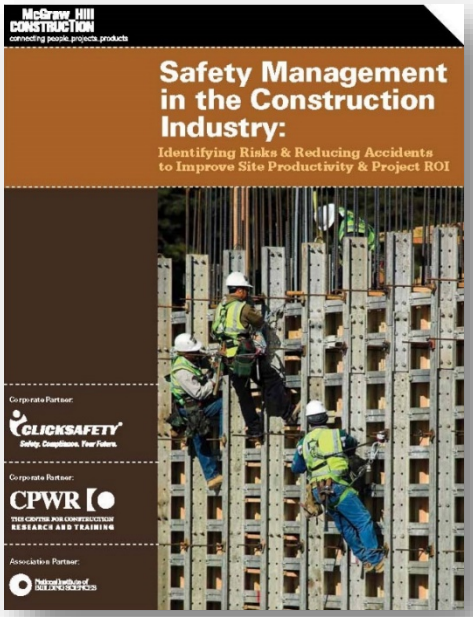
"To me that is probably one of the most significant learnings of the whole accident - the degree to which the inadequacies of that ***experience feedback*** *loop ... Significantly contributed to making us and the plant vulnerable to this accident."*

— Herman Dieckamp
President of the utility at Three Mile Island

Design Expertise + Feedback Loop = PtD



Simplify the Complex … recap



- *Prepare*: Management support & accountability (e.g. copies of tracking lists). Decide & Recruit team. Gather checklists.
- *First Meeting*: Bring worker protection to the table, literally. Multi-discipline: Designers, key end users, Health & Safety pros. Common hazards checklist(s). Brainstorm. (PHL, Preliminary Hazard List)
- *Next meeting*: Rank them. Update w/new inputs. (PHA, Preliminary Hazard Assessment)
- *Future meetings*: Keep checking off eliminated or reduced hazards. Update w/new inputs. (Hazard Tracking List, HTL)
- *Turnover*: Give the customer written guidance for remaining hazards of use and maintenance (Owner's Manual).

Agenda

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  - Introduce Collaborative Design
  - Use a PtD *PROCESS*
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- **SO What ?**

Unique Place of Ergonomics in PtD

A clear and present danger …

- 66 to 78% of lost-time cases ERGO-related
- 40% of workers-comp costs from over-exertion, bodily reaction, repetitive motion … ERGO
- Up to 50% of total claims are ERGO
- Up to 60% of total costs are ERGO

Source: Page 429, *On the Practice of Safety*, Fourth Edition. Fred A. Manuele.

Ergonomics in Process Safety?

If it is too difficult or complicated or nasty to inspect some components …

- How well do you really know the condition of your system?
- You've lost a "leading indicator"
- Mechanical integrity is not assured
- A loss of containment episode is more likely

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PSM & "Accident Investigation"

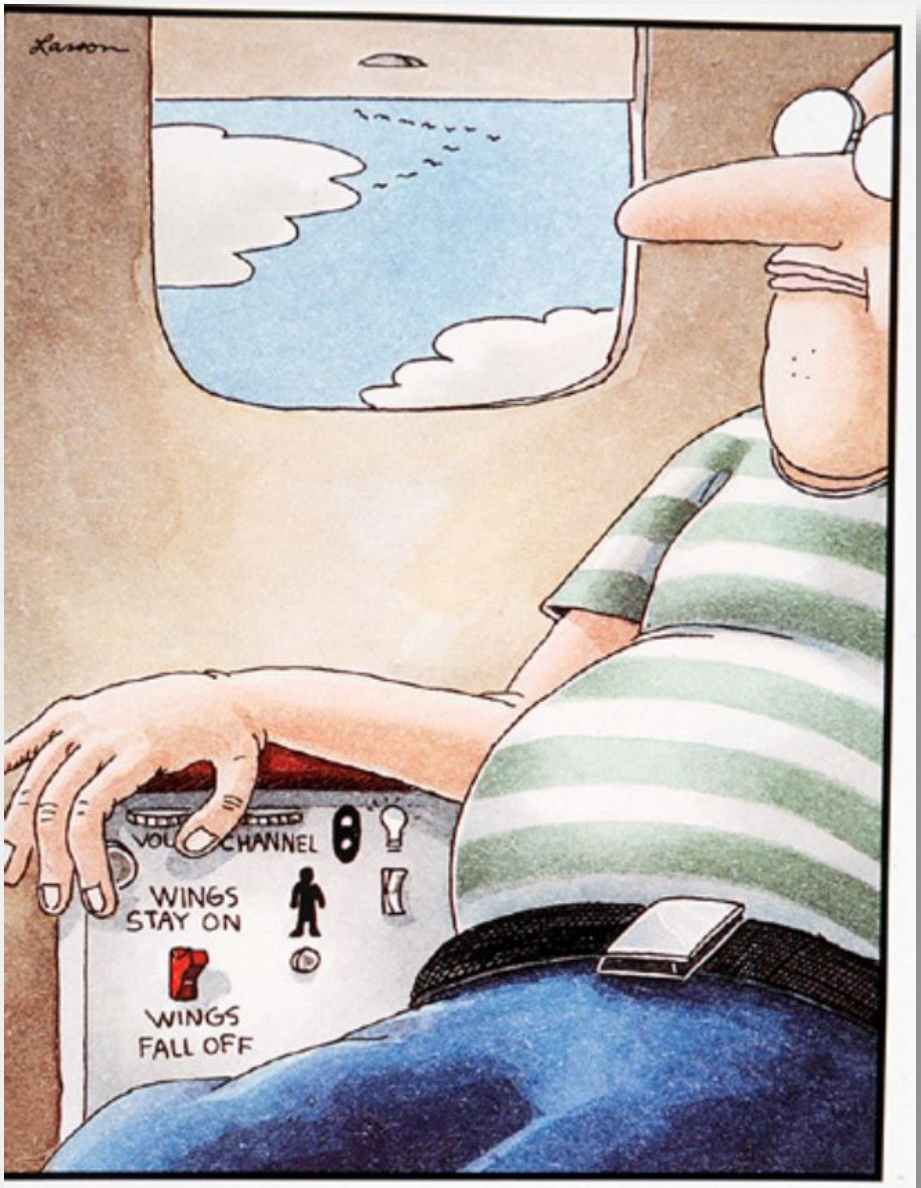
- Regulatory standard applicable to work with highly hazardous chemicals 29 CFR 1910.119
- Major sections include:
  - Process safety information
  - Process hazard analysis and pre-startup safety reviews
  - Operating procedures
  - Employee involvement and training
  - Contractor oversight
  - Mechanical Integrity
  - Management of change
  - Incident investigation
  - Emergency planning and response

You can only "Design Out" what you KNOW

- A *Blame Culture?* "88% human error" (H.W. Heinrich)
  - We "investigate," find human error, and *STOP*
  - We short-circuit analysis and miss ***system*** problems, i.e. contributing factors, root cause**(s)**
  - "Corrective Action?" … re-brief, re-train, re-mind
- Better: A *FACT-finding culture* (not Fault-finding)
  - **START** at human error, don't stop there
  - Find system conditions that *provoke* human error
  - **DESIGN OUT *error-provocative* conditions** – ***PtD!***

PtD
Prevention through Design

Identify, then *design out*, system conditions that *PROVOKE* error



Fumbling for his recline button, Ted unwittingly instigates a disaster.

CDC Workplace Safety and Health
NIOSH

Error Provocative in the real world

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PtD is Ethical Engineering

AIChE Code of Ethics

Hold paramount the safety, health and welfare of the public and protect the environment in performance of their professional duties.

ABET Engineering Accreditation Broadens

ABET (A-K)

Criterion 3. Program Outcomes and Assessment

Engineering programs must demonstrate that their graduates have:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a **system**, component, or **process** to meet desired needs

(d) an ability to function on **multi-disciplinary teams**

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and **ethical** responsibility

(g) an ability to communicate effectively

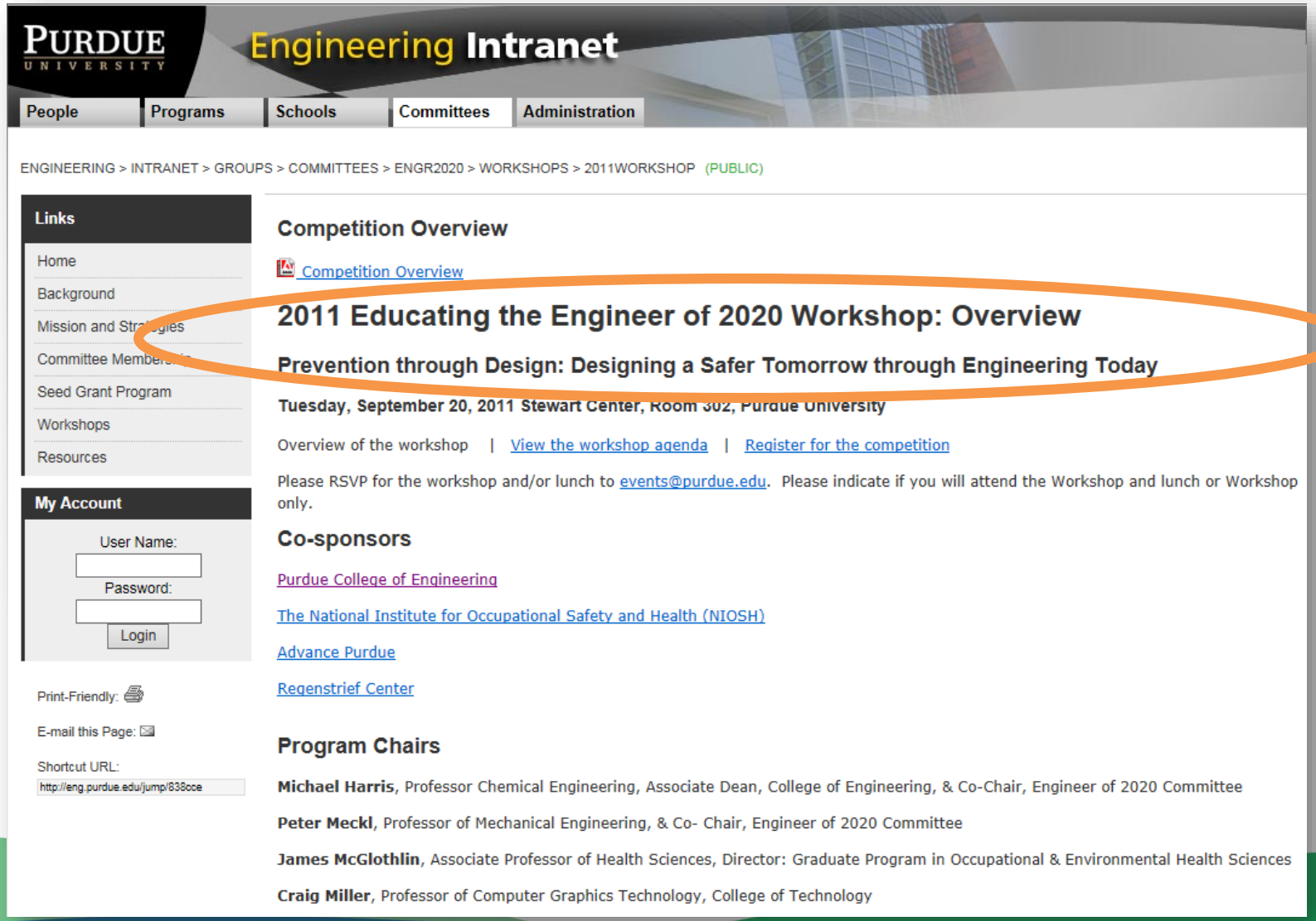
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context

(i) a recognition of the need for, and an ability to engage in **life-long learning**

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Schools are Learning PtD



PURDUE UNIVERSITY Engineering Intranet

People | Programs | Schools | Committees | Administration

ENGINEERING > INTRANET > GROUPS > COMMITTEES > ENGR2020 > WORKSHOPS > 2011WORKSHOP (PUBLIC)

Links

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- Mission and Strategies
- Committee Members
- Seed Grant Program
- Workshops
- Resources

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http://eng.purdue.edu/jump/838cce

Competition Overview

Competition Overview

2011 Educating the Engineer of 2020 Workshop: Overview

Prevention through Design: Designing a Safer Tomorrow through Engineering Today

Tuesday, September 20, 2011 Stewart Center, Room 302, Purdue University

Overview of the workshop | View the workshop agenda | Register for the competition

Please RSVP for the workshop and/or lunch to events@purdue.edu. Please indicate if you will attend the Workshop and lunch or Workshop only.

Co-sponsors

Purdue College of Engineering

The National Institute for Occupational Safety and Health (NIOSH)

Advance Purdue

Regenstrief Center

Program Chairs

Michael Harris, Professor Chemical Engineering, Associate Dean, College of Engineering, & Co-Chair, Engineer of 2020 Committee

Peter Meckl, Professor of Mechanical Engineering, & Co- Chair, Engineer of 2020 Committee

James McGlothlin, Associate Professor of Health Sciences, Director: Graduate Program in Occupational & Environmental Health Sciences

Craig Miller, Professor of Computer Graphics Technology, College of Technology

https://engineering.purdue.edu/Intranet/Groups/Committees/Engr2020/Workshops/2011Workshop

USA Designer liability

YET, where PtD is not required by law, legal counsel has sometimes recommended avoidance of PtD due to designer liability concern …

Designer liability progress

Safer Design often becomes a legal "*duty and standard of care*."

Now, rather than recommend against implementing PtD, legal counsel is now telling the best ways to do it …

Attorneys now advise HOW to DO PtD

An excellent example of a change in approach is found in the specific guidance in the "Clark Hill Construction Law Update" of November 2nd, 2015:

www.clarkhill.com/alerts/prevention-through-design-overview

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What do you do NEXT?

- Leverage Ergonomics! (you may actually want to start here – after good success, explain PtD then start recruiting for a broader PtD design process.)
- Give Examples of PtD Benefits (use these slides and links)
- Teach solutions to common problems (NIOSH ed. Modules, Checklists provided for PDC participants to download)
- Learn from Social Marketing (Involve & learn from end users – choose them wisely)
- Introduce Collaborative Design (add key operators/end users and Safety/Health)
- Use a PtD PROCESS (Management behind it and asking to see hazard tracking sheets, tailor a checklist for a specific project, hold periodic Design Safety Reviews with the above key individuals added to the usual designers, managers) …

What do you do NEXT?

- Do "Accident Investigation" Differently (read and share provided articles, gain management commitment to find facts for continuous improvement - not blame, go from fault-finding to fact-finding for systemic causes, call it "Incident analysis")
- Learn from your Safety Culture Rating (www.cpwr.com/safety-culture)
- Address Liability Concerns (IF it is an issue in your business – see the slides and legal guidance article provided)
- Include Prevention in Additional Contract Provisions ("cement" it into corporate memory)
- Include Prevention in Purchasing Specs (ditto)
- Make a Business Case (Go with simplest first as in examples here. Use calc tools when needed)

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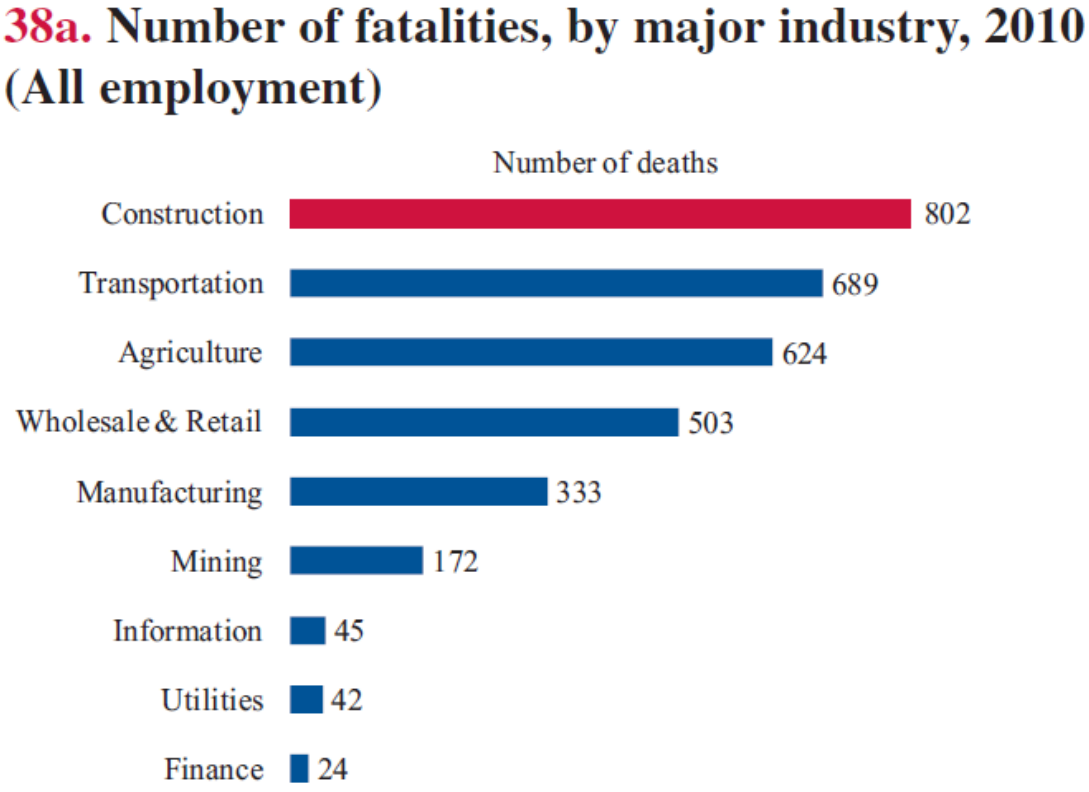
So WHAT?

An Example of YOUR impact …

- Though we never forget the people hurt or killed, we seldom know the ones we saved …
- But we DO save some, many in fact
- Just compare statistics between companies, or even countries – some are WAY better than others
- Statistics aren't numbers, they are people
- They're doing something different and saving people's lives, limbs, and lungs
- Here's an example I ran across in Europe …

Construction kills more people …



- The Construction Chart Book, 5th Ed, 2013 (pg. 38)
  http://www.cpwr.com/publications/construction-chart-book

Saving *FIVE* times the lives …

Construction Fatalities per 100,000 Full-time equivalents (FTE)	
[1]United States: 9.4	[2]Great Britain: 1.62

- [1]The Construction Chart Book, 5th Ed, 2013 (pg. xv) http://www.cpwr.com/publications/construction-chart-book
- [2]Health and safety in construction sector in Great Britain, 2014/2015 (pg. 12) http://www.hse.gov.uk/Statistics/industry/construction/construction.pdf
- See Construction Site Safety, Wikipedia.org, for other countries https://en.wikipedia.org/wiki/Construction_site_safety

Saving *FIVE* times the lives …

- The United Kingdom has a construction fatality rate 1/5th that of the USA.
- That MEANS: For every 5 people who die in our average construction, 4 of them would still be whole and healthy with their families … had they done the same work in the U.K.
- Someone **IS** saving lives. How ?

The "U.K. Toolbox"

- *Great* **Worker Training** and *use* of **Safety Inspections** are some of the tools that save 5 times as many lives in the U.K. *Add* **Leadership** that makes training and inspections happen. *Add* **PtD** – as it is foundational LAW in the U.K. since 1994.

- "But we can't apply U.K. law here"
  TRUE, so **focus** on every point where your **specs** touch on *Training, Inspection, Management accountability*, and include **PtD** additional provisions.

- *This is **LEVERAGE** to save many lives.*

Verified on site with Bill “Edinburgh”

Mr. Bach was so impressed by what he saw at the Edinburgh castle, Scotland, that he interviewed “Bill” the construction manager.

Bill confirmed that the U.K. differences Mr. Bach knew of were in fact true.

(Mr. Bach does not know Bill’s last name, so he is now Bill “Edinburgh”)

So WHAT?

The *Ultimate* Reason

Savings Lives, Saving Families











Questions?