Safe Work Practices and Ergonomic Assessment
SAFETY AND HEALTH MANAGEMENT IN THE PNG INDUSTRY
WITH EMPHASIS ON PROCESS SAFETY AND ERGONOMICS

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Principal, Stoneturn Consultants
Senior Science Advisor, CPWR: The Center for Construction Research and Training
What is CPWR?

- Sponsored by the US building and construction trades unions in cooperation with employers and owners/clients
- Largest private construction safety and health operation in the world
- Consortium of 35 universities
- Responsible for over 30% of all global scientific publications on construction safety and health and over 60% of those reporting on intervention research

www.cpwr.com
Outline

• **Introduction**: The Challenge: how to achieve global best practices *consistently*
• **Backsliding**: How BP went bad (from an EOSH perspective)
• **Relative Risks**: Comparing performance in different engineering sectors
• **Process Safety Management**: Principles and practices with emphasis on *safety case* approach
• **Ergonomics and Human Factors**: Designing for safety
• **Self-regulation or Regulation**: Way forward
THE CHALLENGE: HOW TO ACHIEVE GLOBAL BEST PRACTICES CONSISTENTLY
Bhopal, 1984
Bhopal, 1984

- Engineering enterprises carry potential for very high risks
- Management of risks has improved vastly over past 30 years
- However, it is far from uniform, either between sectors or within sectors
OUR REALITY
US ENERGY DISASTERS 2010

Deepwater Horizon
11 dead

Preventable Failures!

Massey Upper Branch Coal Mine,
29 dead

Kleen Energy,
6 dead

Tesoro Refinery,
6 dead
Preventable Failures!

YOUR REALITY
INDIA ENERGY DISASTERS

Jaipur Oil Depot, 2009,
12 dead

Hazira Oil Depot, 2013,
3 dead
OUR GOAL
GLOBAL HSE PRACTICES IN PETRO-CHEM
Precedent-setting Projects
North Sea, 1980s

Alexander L. Kielland Rig, Norway, 1980
- 123/212 workers killed
Precedent-setting Projects
North Sea, 1980s

Alexander L. Kielland Rig, Norway, 1980
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Piper Alpha Rig, Britain, 1988
• 167/228 workers killed
Precedent-setting Projects
North Sea, 1980s

Alexander L. Kielland Rig, Norway, 1980
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Piper Alpha Rig, Britain, 1988
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Led to systematic thinking about safety culture
Deepwater Horizon, 2010

Led to major changes including nuclear industry-like self-regulation
Backsliding:

HOW BP WENT BAD (FROM AN EOSH PERSPECTIVE)
History

• 1992: BP was model of safety but not profitable

• By 1997:
  – Employment had been reduced from 129,000 to 53,000
  – Profits of 5 Billion USD

• Intent: maximum profits at minimum operating risk

• Reality: short terms profits won out

Preventable Failures!

The Result (EOSH)

- 2005 Texas City Refinery, USA
  15 dead
- 2010 Deepwater Horizon, USA
  11 dead
- 2013 Ula Oil Rig Leak
- 2012 Valhall Oil Rig Fire, Norway
- 2006, 2009, 2011 Alaska Oil Spills, USA
<table>
<thead>
<tr>
<th>Event</th>
<th>Finding</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas City, 2005</td>
<td>The Texas City disaster was caused by organizational and safety deficiencies at all levels of the BP Corporation. BP has not provided effective leadership in making certain its management and U.S. refining workforce understand what is expected of them regarding process safety performance.</td>
<td>U.S. Chemical Safety and Hazard Investigation Board Baker Commission</td>
</tr>
<tr>
<td>Deepwater Horizon 2010</td>
<td>Missed warning signals, failure to share information, and a general lack of appreciation for the risks involved...highlight the importance of organizational culture and a consistent commitment to safety by industry, from the highest management levels on down.</td>
<td>Deepwater Commission</td>
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<td>Valhall Oil Rig, 2012</td>
<td>A number of serious breaches of the regulations related to BP’s management system These relate to lack of maintenance, deficient maintenance management, inadequacies in risk identification and deficient barrier management.”</td>
<td>Norway’s Petroleum Safety Authority</td>
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<td>Ula Oil Rig, 2013</td>
<td>Serious breaches of safety regulations related in part to BP’s management system</td>
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Between 2007 and 2010, BP refineries had **760** "egregious, willful" violations issued by the U.S. Occupational Safety and Health Administration (OSHA), or **97%** of all such violations.

Source: BP’s dismal safety record. 
*ABC News Report, May 27, 2010,* Based on OSHA inspection records

In 2010, BP was barred from receiving contracts from US government
Relative Risks:

COMPARING OSH PERFORMANCE IN DIFFERENT ENGINEERING SECTORS
Source:
From Three Mile Island to the Future
Improving Worker Safety and Health In the U.S. Nuclear Power Industry

A White Paper
Prepared for the Blue Ribbon Commission on America's Nuclear Future
March 14, 2011

Available on www.brc.gov
Click on “Commissioned Papers” in left hand column on home page
Table 8.3: Annual Number of Fatal Occupational Injuries by Utility Sector, 2003-2008

<table>
<thead>
<tr>
<th>Year</th>
<th>Hydro</th>
<th>Fossil</th>
<th>Nuclear</th>
<th>Other</th>
<th>Total</th>
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<td>1</td>
<td>5</td>
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<td>2004</td>
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<td>2005</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>2</td>
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<tr>
<td>2006</td>
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<td>2007</td>
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<td>2008</td>
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<td>0</td>
<td>0</td>
<td>5</td>
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<tr>
<td>Total</td>
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US Sources of Electricity, 2006
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<td>1</td>
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Had the nuclear plants operated at the same risk level during the period 2003-2008 as:
- hydro plants = 29 fatalities,
- fossil fuel plants = 13 fatalities
<table>
<thead>
<tr>
<th>Industry</th>
<th>NAICS</th>
<th>Injury and Illness Rates**</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td>Recordable</td>
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<tr>
<td>Nuclear Facilities</td>
<td>221113</td>
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<tr>
<td>Computer Storage Device Mfg</td>
<td>334112</td>
<td>0.8</td>
</tr>
<tr>
<td>Finance and Insurance</td>
<td>52</td>
<td>0.8</td>
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<tr>
<td>Pharmaceutical Manufacturing</td>
<td>3254</td>
<td>2.0</td>
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<tr>
<td>Chemical Manufacturing</td>
<td>325</td>
<td>2.3</td>
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<tr>
<td>Aerospace Manufacturing</td>
<td>3364</td>
<td>3.3</td>
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<tr>
<td>All Manufacturing</td>
<td>31-32</td>
<td>4.3</td>
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<tr>
<td>Hospitals</td>
<td>6221</td>
<td>7.3</td>
</tr>
<tr>
<td>Steel Products Manufacturing</td>
<td>3312</td>
<td>7.6</td>
</tr>
<tr>
<td><strong>Average for All Private Industry</strong></td>
<td>-</td>
<td>3.6</td>
</tr>
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</table>

**Number per 100 FTE workers in industry
OII Data, 2009

Occupational Injuries and Illnesses

- Nuclear
- Hydro
- Fossil
- Other
Recordable Injury Rate by Sector

Year:
- 2006
- 2007
- 2008
- 2009

Rate/100 FTE

Sectors:
- Nuclear
- Hydro
- Fossil
- Other

Graph shows trends in injury rates for different sectors over the years.
DART for Outage Work 1997-2010

Year

Rate/100 FTE

Fossil
Nuclear

0 0.1 0.2 0.3 0.4

97 98 99 00 01 02 03 04 05 06 07 08 09 10

Fossil Nuclear
Maintenance: Nuclear v. All

NAICS 238
Maintenance in Nuclear Plants

Rate/100 FTE
Process Safety Management:

PRINCIPLES AND PRACTICES WITH EMPHASIS ON SAFETY CASE APPROACH
General Flow

Environment

- Pressures/Explosives
- Toxics
- Physical hazards
- Equipment hazards
General Flow

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Safety Systems
- Design and planning
- Operations Mgt
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Human Factor
• Cognition/perceptions
• Culture/traditions
• Expectations
• Limitations
General Flow

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- Cognition/perceptions
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- Limitations
Principles of Process Safety

Safety is a “collective” responsibility/Building a Safety Culture

• Everyone is personally responsible for safety.
• Leaders demonstrate commitment to safety.
• Trust permeates the organization.
• Decision-making reflects safety first.
• Each process/operation is recognized as special and unique.
• A questioning attitude is cultivated.
• Organizational learning is embraced.
• Safety organization, procedures, and results undergo constant examination.
OSHA 20-year Experience with Chemical Process Safety

• Rights and duties of employees to participate not defined well enough

• Documentation of safety audit methods, findings and corrective actions inadequate

• Mgt is not obliged to accept or reject findings of plant safety audit teams
The Key Tool to Process Safety

The Safety Case

• Based on ALARA/ALARP and the Precautionary Principle
• Applies all processes
• Adopting the best option based on *life-cycle* assessment
• Using the best available risk assessments and clearly defining any uncertainties
• The duty holder must sign off on each case and be accountable for it
General Approach (HSE)

“There is no Single Approach”

- Identification and consideration of a range of potential measures for further risk reduction,
- Systematic analysis of each of the identified measures and a view formed on the safety benefit associated with each of them,
- Evaluation of the reasonable practicability of the identified measures,
- The implementation (or planned implementation) of the identified reasonably practicable measures,
- Recording of the process and results, and these are summarised in the safety case.
DESIGNING FOR SAFETY

Ergonomics and Human Factors:
The Most Common OSH Problems

• Outcomes
  – Acute
    • Lacerations (minor cuts)
    • Fractures
    • Eye injuries
    • Sprains
  – Long-term
    • MSDs
    • Hearing loss
    • Diseases
The Most Common OSH Problems

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• Prevention
  – Design (incl ergonomics)
  – Work Organization
  – Housekeeping
  – PPE
The Most Common OSH Problems

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• Prevention
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*MSDs contribute to disability in 90% of US population with disability*
Common Sources of MSDs

- Overexertion
  - Manual handling of loads
  - Other
- Repetitive motions
- Work in awkward postures
- Vibration
- Effects of extreme heat and cold
Reducing MSD Risks

1. Develop task-specific solutions
2. Implement participatory ergonomic programs
3. Identify the characteristics of both the industry and of employers that impact diffusion of innovations and solutions
One Task, Lots of Hazards
Awkward Posture Leads to Rotator Cuff Inflammation
Repetitive Motions Lead to CTS
Reducing MSD is Common Sense

1. Develop task-specific solutions
2. Implement participatory ergonomic programs
3. Identify the characteristics of both the industry and of employers that impact diffusion of innovations and solutions
Prevention Can Be Had
Factors influencing adoption of controls

- Cost
- “We have always done it this way”
- Complexity/practicality
- Project design
- Materials specifications
- Materials production
- Site management systems
- Job site conditions
- Regulatory climate, unfair competition from poor performers
Participatory Ergonomics (PE)

Managers and workers come together to develop common sense solutions to task-specific problems.
Participatory Ergonomics (PE)

Managers and workers come together to develop common sense solutions to task-specific problems.

PE builds company/worker specific capability

A program approach is needed in engineering enterprises because the industry has countless tasks with significant physical hazards

PE fits engineering - common use of problem solving and improvisation
Framework for PE

- Choose problems through consensus process
- Identify obstacles and stimuli in the social and organizational context
- Set SMART goals: specific, measurable, achievable, realistic, timed
- Select implementation strategy
- Develop a specific implementation plan
- Measure impact
PE Solutions save injuries and save money
The Biggest Obstacle

• Poorly trained and prepared front line supervisors
Way Forward

SELF-REGULATION OR REGULATION
Deepwater Horizon Commission

"...government oversight alone, cannot reduce...risks to the full extent possible. Government oversight...must be accompanied by the oil and gas industry's internal reinvention: sweeping reforms that accomplish no less than a fundamental transformation of its safety culture.”
Deepwater Horizon Commission

"...government oversight alone, cannot reduce...risks to the full extent possible. Government oversight...must be accompanied by the oil and gas industry's internal reinvention: sweeping reforms that accomplish no less than a fundamental transformation of its safety culture."

These findings referenced the experience of the US nuclear power industry
Average Annual Radiation Dose per Worker with any Dose in Rem (1 rem=0.01 Sv / 1Sv=100 rem)
To what Can Improved Safety be Ascribed

• Fear of regulation
• Market forces
• Regulation
• Self regulation: INPO
Average Annual Radiation Dose per Worker with any Dose in Rem (1 rem=0.01 Sv / 1Sv=100 rem)
Strengths of INPO, the Self Regulator

• Right to enter all nuclear plants
• Assures total confidentiality
• Highly qualified inspectors/consultants
• Only insurer of nuclear plants
• CEO peer critiques
Average Annual Radiation Dose per Worker with any Dose in Rem (1 rem=0.01 Sv / 1Sv=100 rem)

TMI/INPO

Safety Culture Emphasis
Strengths of Regulator (NRC)

Annual Inspection Hours Per Plant

![Bar Chart]

- **No of Facilities**
  - 3000-3999
  - 4000-4999
  - 5000-5999
  - 6000-6999
  - 7000-7999
  - 8000-8999
  - 9000-999
  - >10000

- **Inspection Hours**
  - 0
  - 5
  - 10
  - 15
  - 20
  - 25
  - 30

The chart illustrates the distribution of inspection hours across different ranges of facilities.
Two Approaches to Establishing Safety Cases

• In UK,
  – The duty holder is responsible for the safety case and signs off on it
  – Regulator (HSE) actively involved in and approves all major safety cases

• In Norway,
  – Employers and workers together develop safety procedures and sign off on them.
  – Workers are entitled to resources that gives them technical parity with employers
  – Regulator (PSA) establishes conditions under which safety cases are conducted, and certifies that those procedures are followed
Finally....

CONCLUSIONS
• In high hazard industries, safety has to be above all other values
• Safety has to be a collective responsibility
• High hazard industries should embrace industry-wide self-regulation
• Regulation alone is not sufficient to assure safety, but it is the backbone
• Regulation cannot be based on enforcement of prescribed standards alone or even primarily: it must be shaped to force continuous improvement of safety processes/safety culture
• Use of safety cases should be the operational core of process safety
Thank you!

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