



# Hazard Assessment and Confined Spaces: Keeping Ahead of the Arrows

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# Confined Spaces: What We Know

- not the type of place in which people normally work
- accidents are rare events, very difficult to predict and very expensive to prevent
- same accident highly unlikely to reoccur
- minor mistakes → major consequences
- accidents more severe than in 'normal' workspaces

# Confined Spaces: What We Know

- pre-existing conditions + work activity create the hazardous conditions
- hazards = atmospheric + safety
- atmospheric accidents:
  - rapid onset, ~10 min after entry
  - often multiple fatalities
  - victims = accident victim + would-be rescuers
- accidents with other causes usually less severe

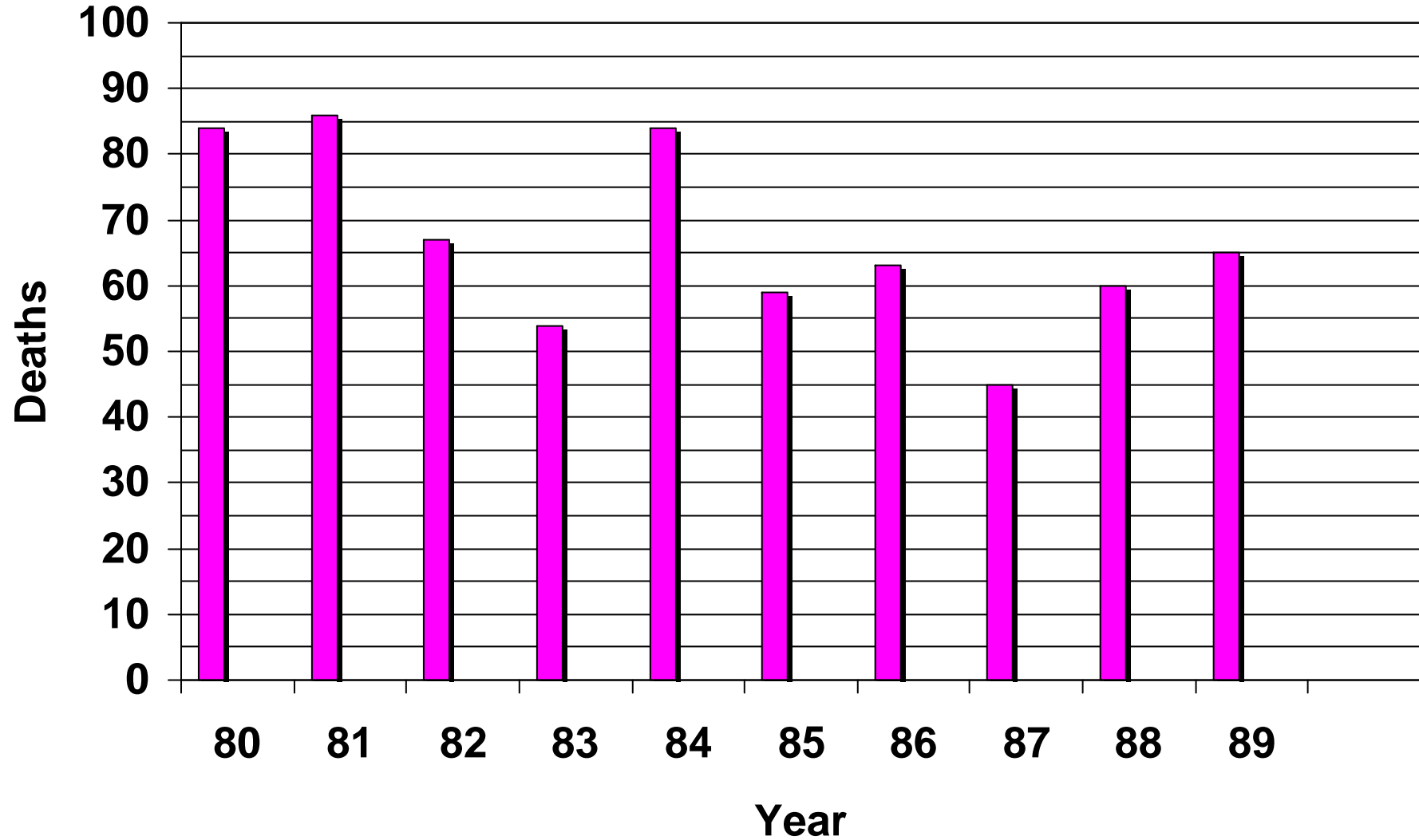
# Recent History

- concerns date back to the early 1900s
- fires and explosions in transportation and chemical processing
- oxygen-deficient conditions in wells and underground structures
- gases produced in wastewater treatment systems
- 1922: NFPA 306 (gas hazards on vessels)

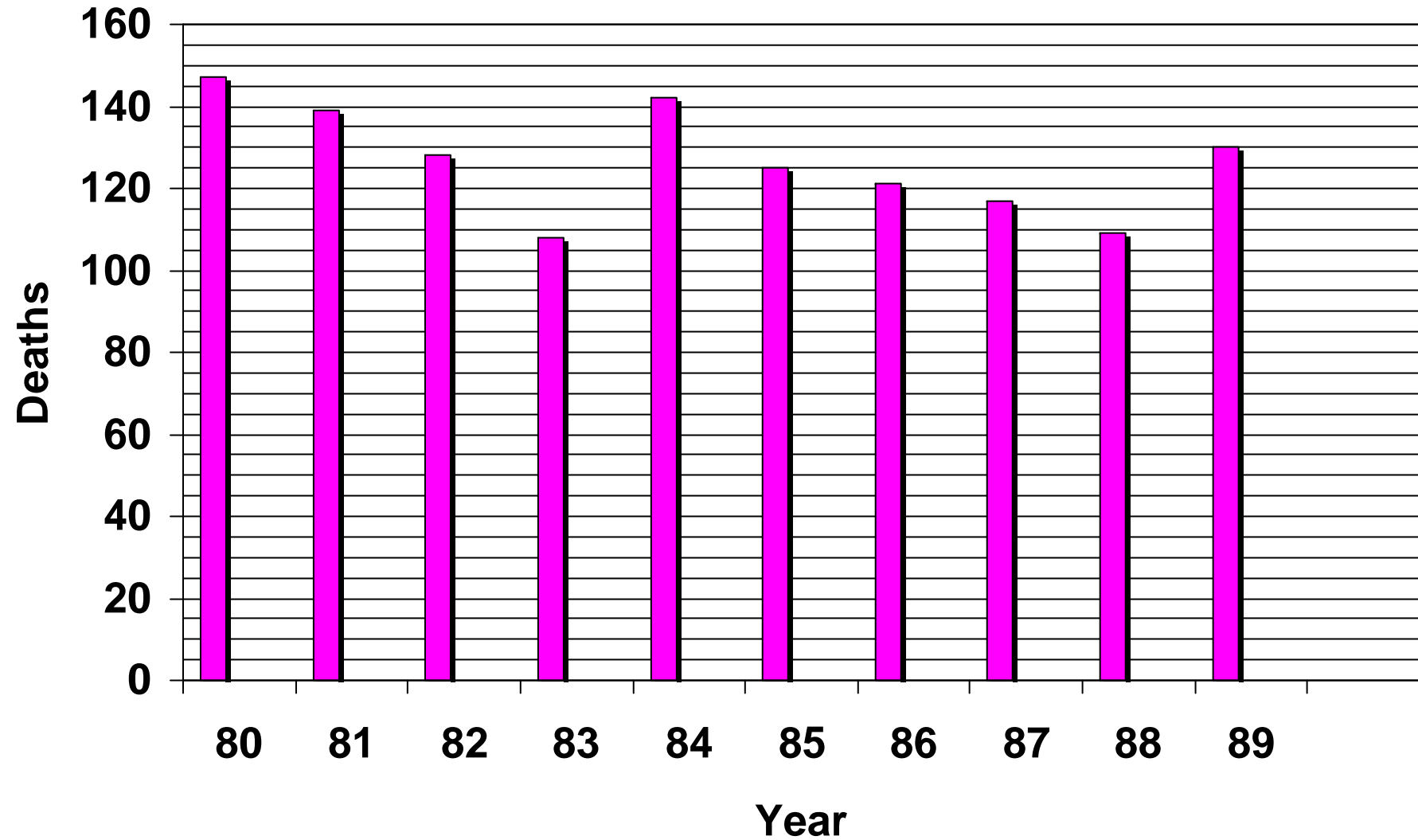
# Recent History

- regulatory requirements:
  - Australia since at least the 1960s
  - Canada since at least the 1970s
- 1977: ANSI Z117 consensus standard
- 1979: NIOSH criteria document
- 1980s: OSHA fatality reports
- 1994: NIOSH, Worker Deaths in Confined Spaces

# Deaths in Confined Spaces (NIOSH 1994)



# Trenches + Confined Spaces (NIOSH 1994)



# So, Where Are We Today?

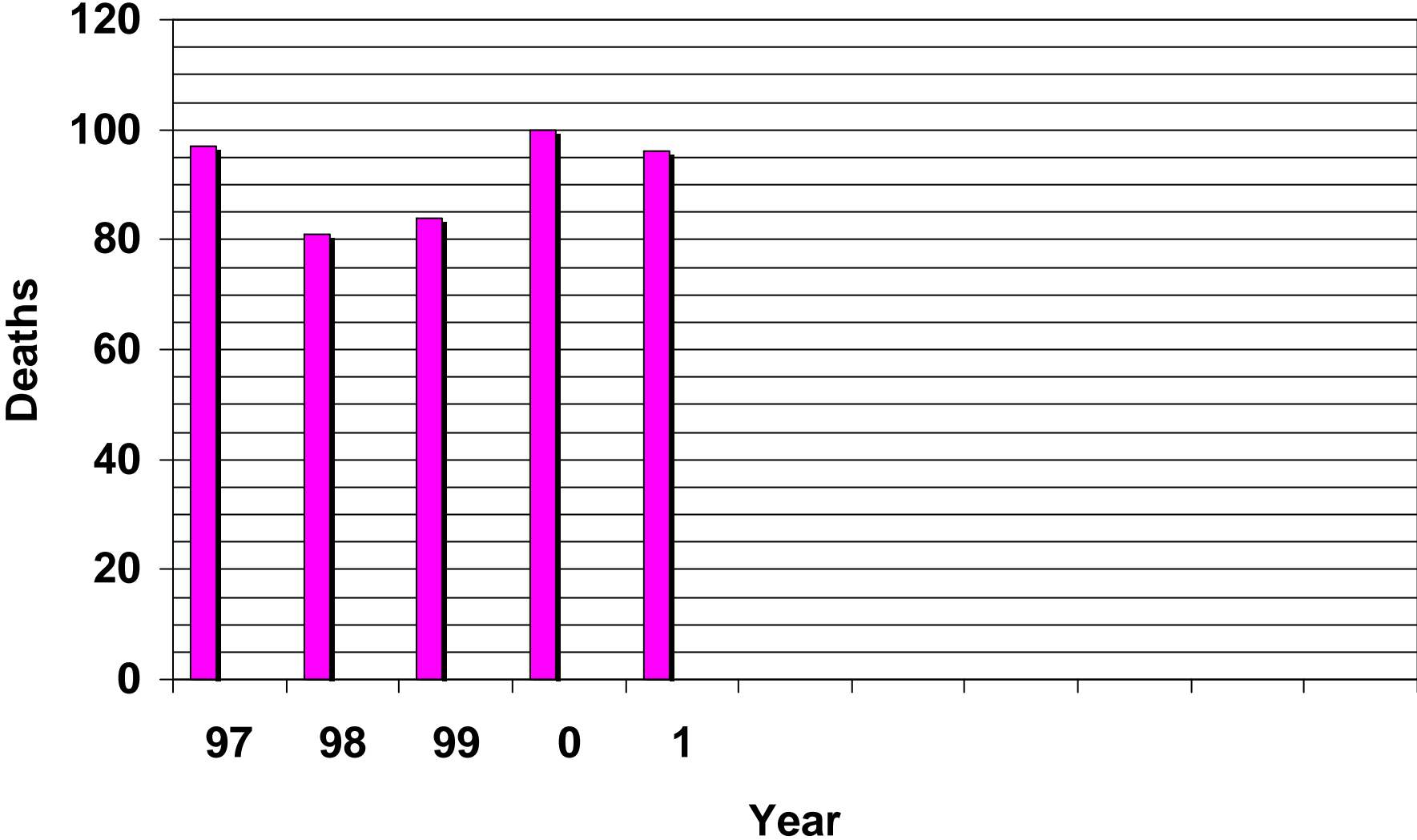
- consensus standards (ANSI Z117.1, AS2865, NFPA 306, CSA 1006)
- regulatory requirements in many jurisdictions
- a lot of money and effort expended for unknown outcome!!!



# How Well Are We Doing?

- preamble to OSHA 1910.146 estimated full implementation to save 53 lives/\$202 million/year. Is this happening???
- last detailed data provided by U.S. Bureau of Labor Statistics (BLS) in 2004
- where are the contributions to the knowledge base from other countries?

# Deaths in Confined Spaces (BLS 2004)



# A Disturbing Reality

- highly consequential rare events are occurring with increasing frequency in North America
- sometimes involve large employers
- not being prevented because they happen
- beyond the scope of normal practice of OH&S
- the OH&S establishment appears to be incapable of influencing the outcome of these situations

# Emergent Themes in Accidents

- limit of information processing – conflict between task and conditions
- lack of knowledge versus knowledge
- helplessness versus control
- violation versus compliance
- level of management oversight

# Task Versus Conditions

- task and conditions are different realities that exist simultaneously
- workers focus on task
- hazardous conditions cause accidents
- simultaneous focus on task and conditions not possible – limitation of information processing

# Level of Knowledge

- visitors depend totally on information provided by site personnel
- workers, supervisors, management gain considerable knowledge from prolonged employment at a site
- knowledge reduces risk

# Level of Helplessness

- ability to influence conditions greatly influences the occurrence of accidents

no control ←————→ control

- visitors usually helpless to influence the situation
- helplessness increases risk of accident

# Compliance versus Violation

- reflects value judgement about occurrence and level of risk
- inconvenience factor is important determinant
- compliance with safe procedures reduces risk



# Where Must We Go From Here?

- how do we stop highly consequential rare events when there is no indication of success, only failure?
- there is no  $A \rightarrow B \rightarrow C$ , only  $A \rightarrow ???$
- need for:
  - considerable enhancement of anticipation and recognition skills of OH&S practitioners
  - more knowledgeable workforce

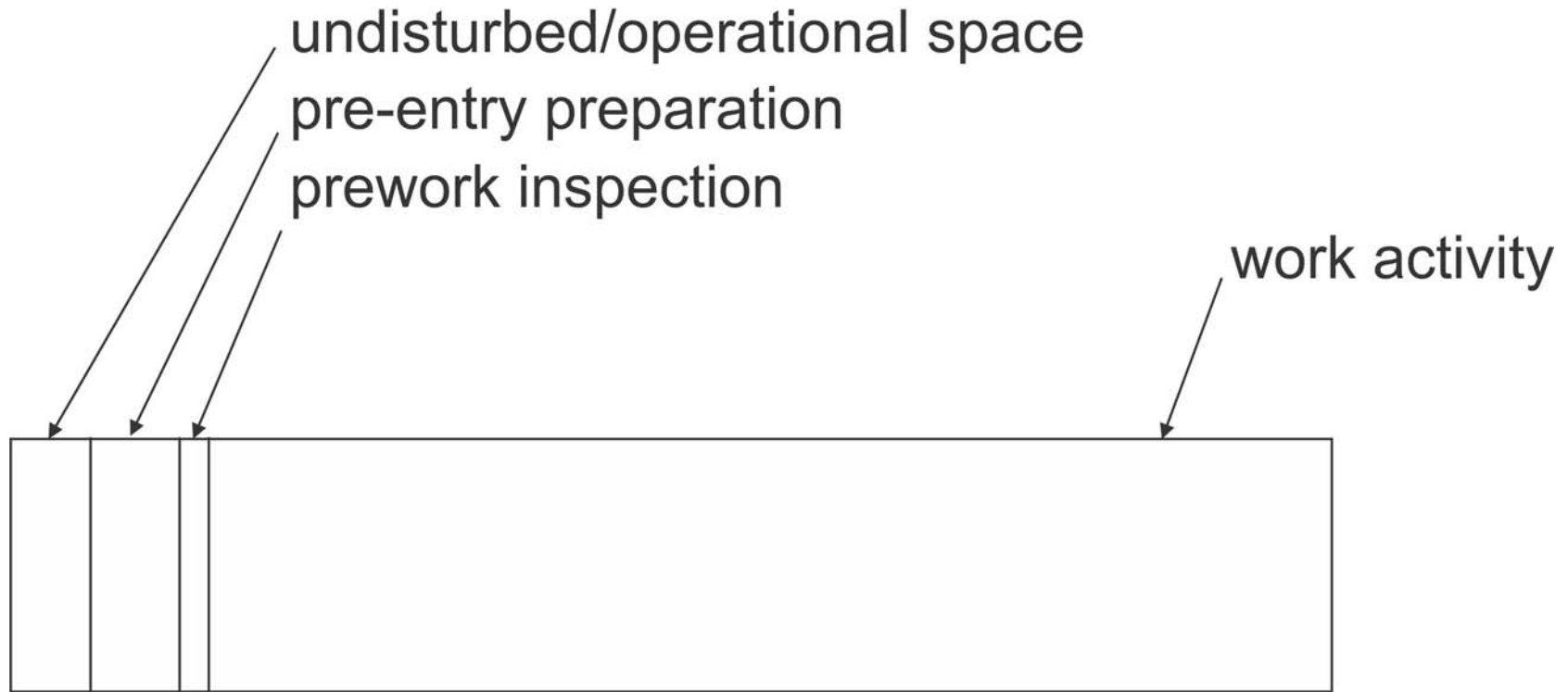
# Activity Management

- activities are either managed or allowed to happen
- management is an attempt to gain and maintain control over direction and/or magnitude of downgrading factors
- control minimizes risk of work
- loss of control leads to higher than necessary risk and impact

# Operating Cycle: Confined Spaces

- undisturbed/operational space
  - pre-entry preparation
  - pre-work inspection
  - work activity
  - emergency response
- 
- hazardous conditions depend on the point in the operating cycle

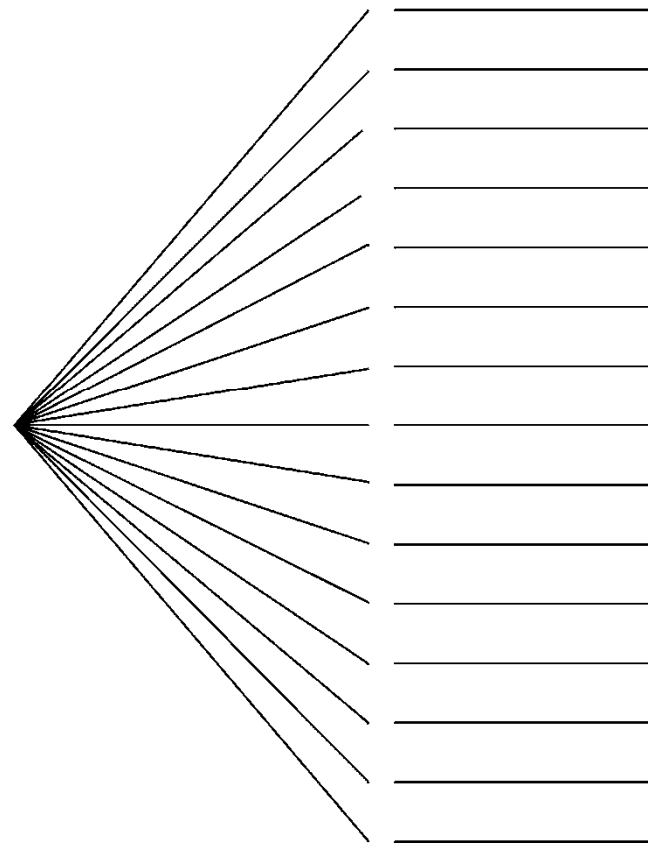
# Confined Space Operational Cycle



# Confined Space = A Zipped File

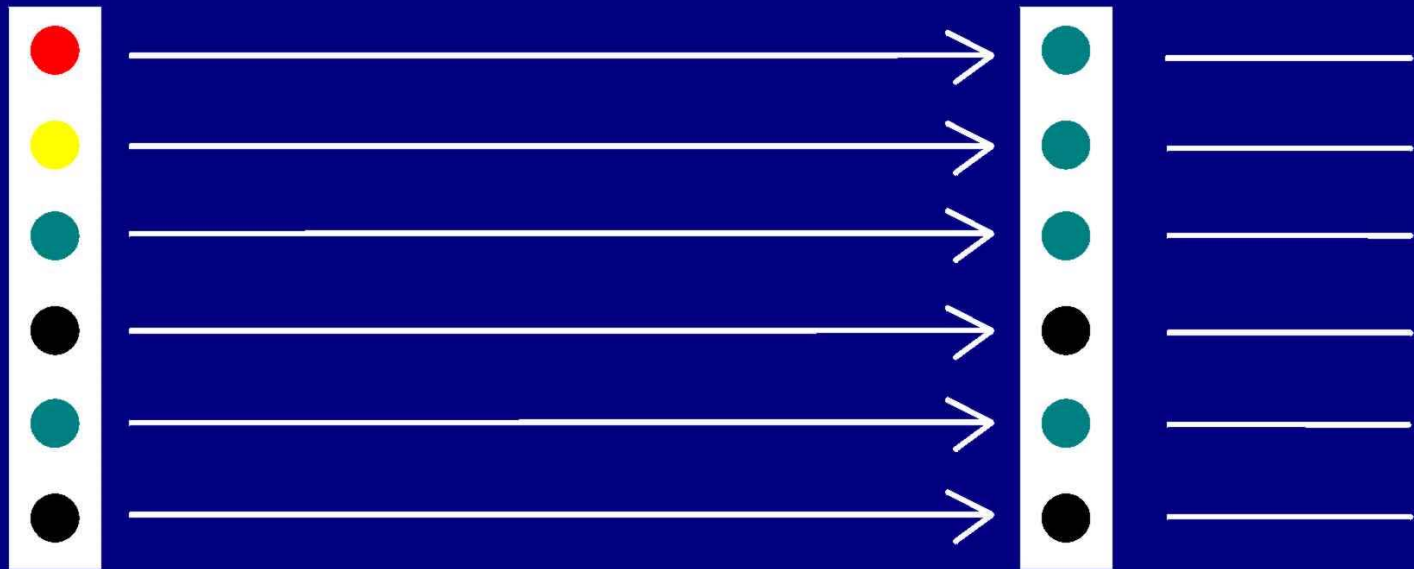
Hazard Anticipation/Identification

confined space



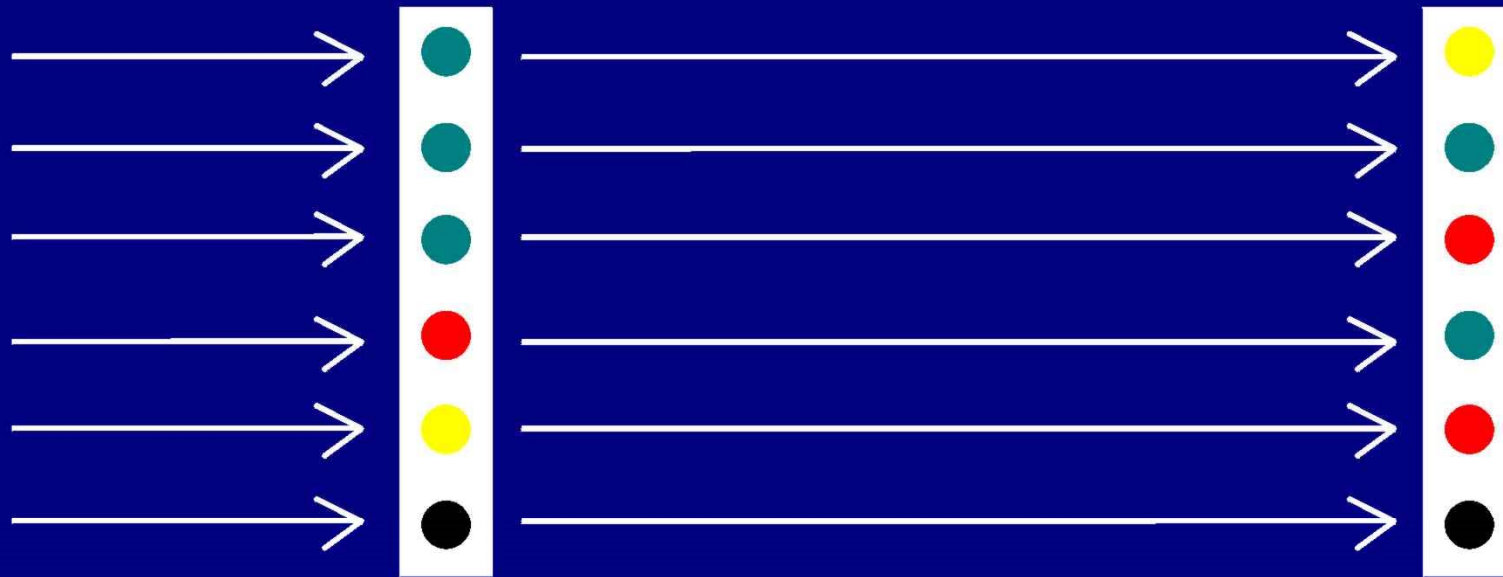
Undisturbed Space

Pre-entry Preparation



Pre Work Inspection

Work Activity



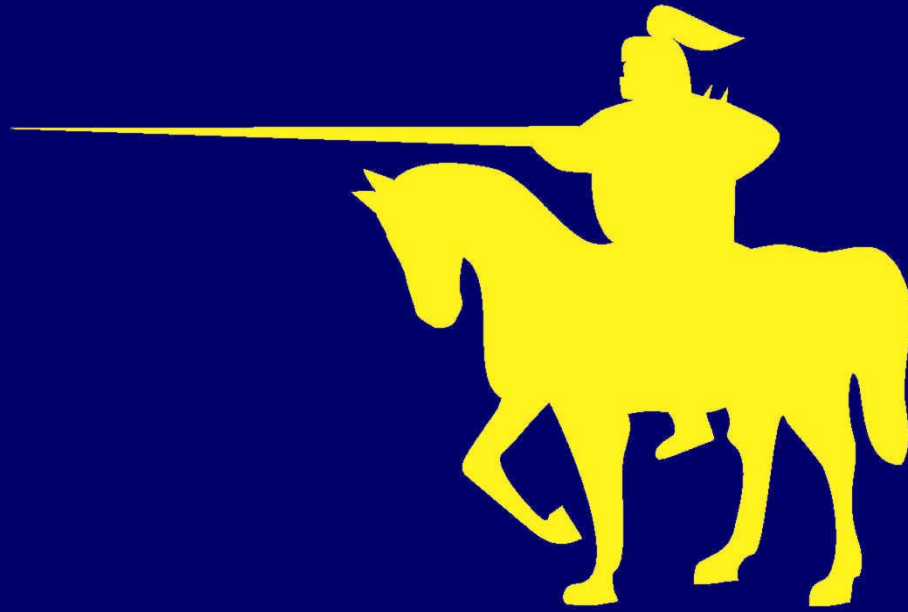
# Entry Management Systems

- entry permit
- entry certificate
- hazard assessment + written procedure
  
- every system depends on a 'qualified person', identified or not identified



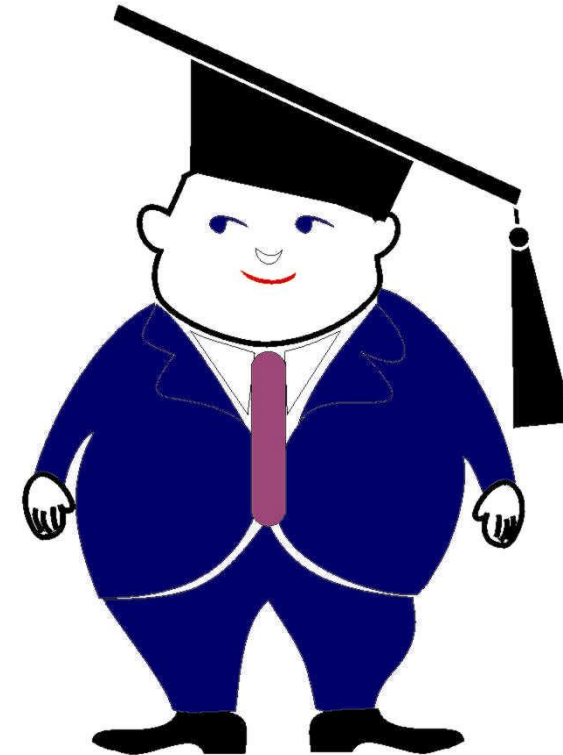
# The Qualified Person

- identified in standards and guidelines on various topics
- vaguely described by education, training, experience
  - who is qualified?
  - what training is required to become qualified?

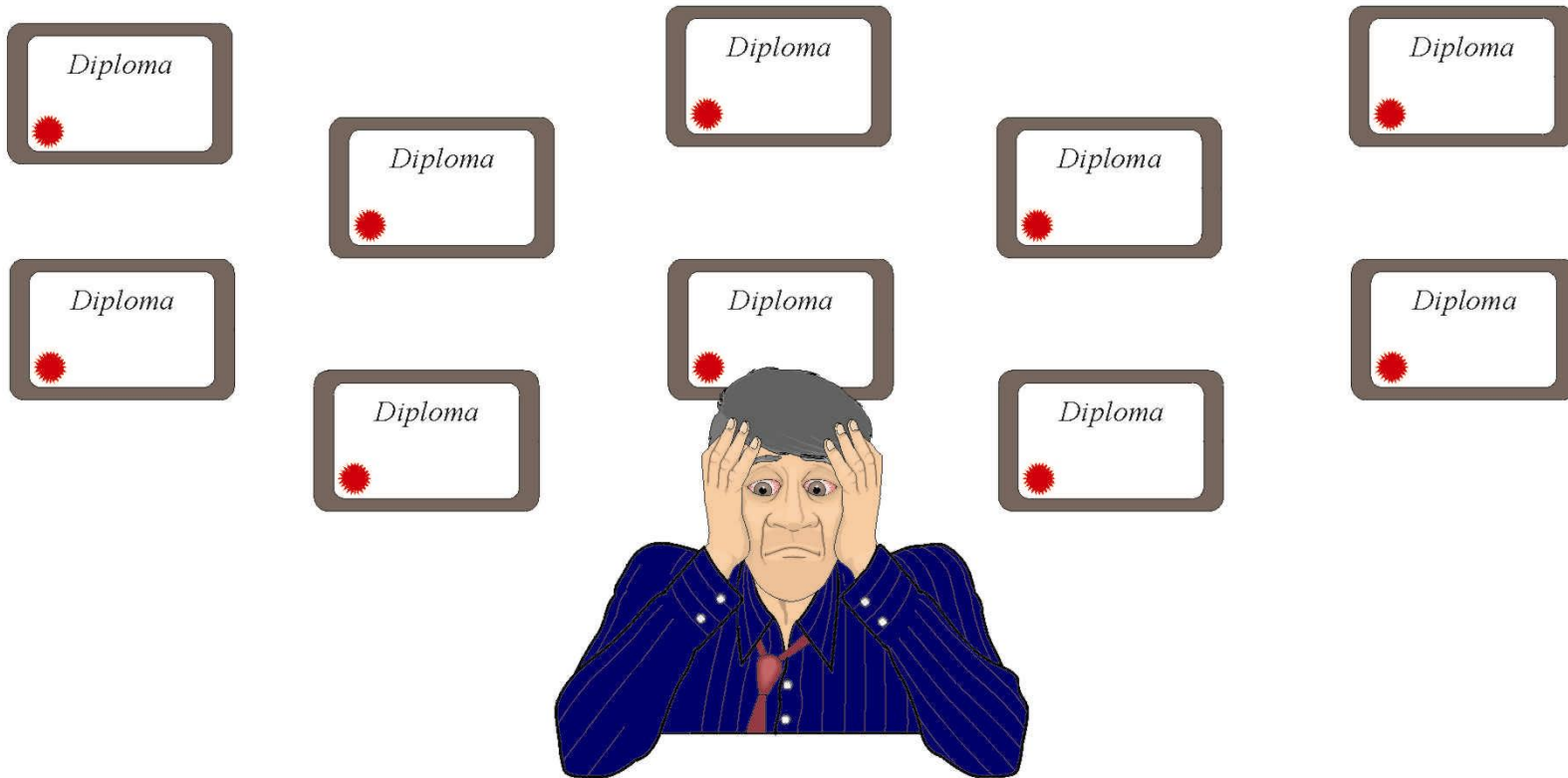


The Qualified Person  
as seen by standard setters

*5-Day Course  
Qualified Person*



The Qualified Person  
as seen by Some



# The Qualified Person Self Image

# Entry Permit System

- Yes/No checklist + record of conditions
  - completed by entry supervisor
  - updated by successive entry supervisor and tester
- 
- example: 29CFR 1910.146 (USA)

# Entry Permit System: Comments

- repeatable?
- technically correct?
- appropriate in the circumstance?
- responsive to conditions created during work activity?
- no formal education/training/certification or demonstration of knowledge or competence required

# Entry Certificate System

- marine chemist or shipyard competent person inspects the space and completes the certificate
- certificate contains standard language:
  - safe for workers, not safe for workers
  - enter with restrictions
  - safe for hot work, safe for limited hot work, not safe for hot work
- example: 29CFR 1915 (USA)

# Entry Certificate System: Comments

- workers, supervisors must understand intent of language
- shipyard competent person: low-level training
- Certified Marine Chemist: highly trained
- repeatable?
- technically correct?
- appropriate in the circumstance?
- responsive to conditions created during work activity?



# Hazard Assessment + Procedure

- Qualified Person assesses hazardous conditions:
  - prior to or during entry
  - during work activity
- prepares written procedure for entry and work activity
- example: Part 9, OH&S Regulation, WorkSafeBC (British Columbia, Canada)

# Qualified Person (WorkSafeBC)

- CIH or ROH, CSP or CRSP, or P.Eng. + experience in the practice of occupational hygiene related to confined space entry
- other combination of education, training and experience acceptable to WorkSafeBC
- WorkSafeBC: credentials do not make one qualified; experience in the practice of OH&S related to confined space work is essential

# Hazard Assessment

- hazard assessment = hazard identification + detailed commentary
- hazard identification = hazardous conditions present during entry or work
- hazardous condition = situation capable of causing injury, impairment or death or overexposure
- commentary based on experience, research

# Hazard Assessment

- anticipate what could be there
- recognize it when it is there
- predict severity of hazardous conditions
- requires knowledge about:
  - processes and operation of equipment
  - potential magnitude of emissions
  - measures to eliminate or control hazardous conditions
  - personal and other protective equipment

# Control Measures

- hazard assessment → control measures
- control measures should eliminate or at least control hazardous conditions

# Comments

- document can apply to group of spaces posing similar hazardous conditions
- preparation requires time
- documents evolve with experience, knowledge and skill
- repeatable and defensible

ABC Company	Confined Space Identification and Hazard Assessment	Pressure Vessel Conversion
<b>Owner:</b>	Location:	Assessor: Neil McManus, TIA, CSP, CPO, CRP, Registered (PPE)
<b>Work Activity:</b>	Intended for permanent occupancy?	Site: [Redacted]
<b>Hazardous:</b>	Functionality: Storage, Original Use Intended?	Adjustment: Not applicable
<b>Confined Space:</b>	Equipment not applicable	Pressure: Not applicable
<b>Permit Required:</b>	Emergency Evacuation: Not applicable	Permit: Not applicable
<b>Pressure Vessel:</b>	Permitted: No	

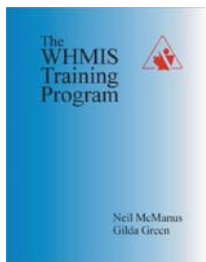


ABC Company	First Aid Assessment	Pressure Vessel Conversion
<b>Owner:</b>	Work Location:	Assessed by: Neil McManus
<b>Project:</b>	Number of Workers: 1	Site: [Redacted]
<b>Work Activity:</b>	Probable Incidents/Injuries:	Pressure Vessel:
<b>Hazardous:</b>	Types of Work Activities/Injuries:	Emergency Evacuation:
<b>First Aid:</b>	First Aid Required: Yes, Level 1	Permit: Not applicable
<b>Emergency Evacuation:</b>	Emergency Evacuation: Yes, Level 1	Equipment: Not applicable
<b>Pressure Vessel:</b>	Permitted: No	



hazard assessment

emergency response assessment



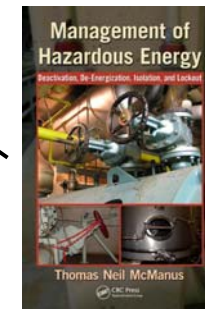
ABC Company	Confined Space Procedure	Abrasive Blasting
<b>Permit Required:</b> No	<b>Sign Admin:</b> Tel: 888-888-7222	<b>Prepared by:</b> Tel: 888-888-7222
<b>Equipment Required:</b>	<b>Co-ventilation of Work Activities:</b>	
<b>Equipment Required:</b>	<b>Verification &amp; Testing:</b>	
<b>Work Procedure:</b>		

work procedure

hazardous energy assessment

Big Iron Bridge Company	Portable Ventilation Assessment	Pressure Vessel Conversion Assessment
<b>Owner:</b> Big Iron Bridge	Location: Horizon Bridge	Assessed by: Neil McManus
<b>Project:</b>	Number of Workers: 1	Site: [Redacted]
<b>Work Activity:</b>	Probable Incidents/Injuries:	Pressure Vessel:
<b>Hazardous:</b>	Types of Work Activities/Injuries:	Emergency Evacuation:
<b>First Aid:</b>	First Aid Required: Yes, Level 1	Permit: Not applicable
<b>Emergency Evacuation:</b>	Emergency Evacuation: Yes, Level 1	Equipment: Not applicable
<b>Pressure Vessel:</b>	Permitted: No	

ventilation assessment



# OH&S Practitioner's Worst Nightmare

IF

- all accidents are regarded as preventable,

AND

- lack of knowledge is a major contributing factor,

THEN ...

What is the accountability of OH&S practitioners in these outcomes?



# OH&S Practitioner's Worst Nightmare

Being unknowing about the existence of hazardous conditions, unable to anticipate what could be present, or unable to recognize them when they are present, and unable to influence their expression surely must constitute the OH&S practitioner's worst nightmare.

# Practitioner Credential (North America)

- graduate in science
- undergraduate or graduate programs available in OH&S
- $\geq 5$  years of experience
- examination delivered by credentialing body
- knowledge base defined by the 'prep' course (2 to 3 days) or academic curriculum
- recertification = point-gathering exercise

# OH&S System (Brazil)

- company must assess risk of the operation
- if the risk combined with the number of workers exceeds a regulatory threshold, the company will employ one or more of:
  - safety technician
  - safety engineer
  - nurse
  - occupational health physician

# Safety Engineer (Brazil)

- post graduation training in safety engineering
- licensed by the State board (enforceable code of ethics, criminal responsibility)
- 660 hours of classroom training
- defined curriculum
- specialization, not Master's degree
- 50,000 to 75,000 safety engineers trained

# Improving The Pedigree ...

- define the body of knowledge needed to prevent accidents
- combine hygiene and safety to maximize anticipation, recognition and intervention
- expand certification requirements to reflect depth and breadth of knowledge needed for accident prevention

# Improving The Pedigree ...

- strengthen expectations of codes of ethics regarding action by individuals to prevent accidents
- support individuals who act proactively to prevent accidents
- publicize and enforce codes of ethics

# What Qualified Really Means

Qualified is a state of attainment such that no one will suffer accident, injury or death as a result of deficiency of judgment brought about by deficiency of knowledge.

We expect our surgeons and plumbers to be able to address unusual conditions in a competent manner. The same expectation must apply to OH&S practitioners.

# In Conclusion

- preventing rare events requires knowledge and skill sets beyond those needed for routine practice of OH&S
- the worst nightmare of OH&S practitioners is to be unprepared for one of these episodes
- the OH&S establishment increasingly appears to be unable to respond to this challenge
- this situation argues for upgrading of capabilities implicit in credentials