A User's Guide to Preventing Major Accidents

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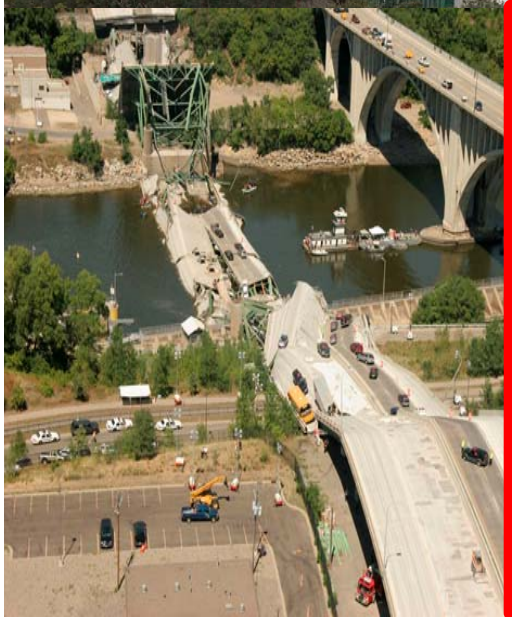
100 Years Ago

This Year

Past 5 Years



Objectives

- What is the cost of safety?
- Why do major accidents occur?
- How does organizational culture affect safety?
- So what is a leader to do?
- What is the lesson here?

The Cost of Safety

- Ensuring that adequate resources are allocated to safety programs is always difficult – there is no golden ratio
- Measuring a safety program's effectiveness is also difficult
- What is the cost of an accident avoided?
- An absence of accidents is often interpreted as an indication that the safety program is no longer needed
- As a result:

Poor safety is "penalized" by gaining resources

and

Good safety is "rewarded" by losing resources

The Cost of Inadequate Safety

- K-25 - welder fatality during hot work in contaminated area; February 1997
- Hanford - red oil explosion in plutonium facility; May 1997
- LLNL - curium release with uptake while shredding waste; July 1997
- SRS - plutonium release with uptakes from faulty packaging; September 1999
- LANL - plutonium release with uptakes during glovebox maintenance; March 2000
- LLNL - high radiation dose to the extremities while working in glovebox; June 2002
- LANL - plutonium release with uptakes from faulty packaging; August 2003
- OR – contamination spread during offsite transport of radioactive waste; May 2004
- LLNL - plutonium release with uptakes while repackaging waste; August 2004
- LANL – americium release from glovebox with uptake and offsite impacts; July 2005
- LANL – two separate contaminated puncture wounds in gloveboxes; January 2007
- Hanford – Tank S-102 high-level waste spill; July 2007
- LLNL - Glovebox over-pressurization while processing uranium waste; January 2009
- SRS - contaminated puncture wound while working in glovebox; June 2010
- SPRU - contamination spread during demolition of building; September 2010
- INL - plutonium contamination of workers while repackaging fuel; November 2011

Nothing is more expensive than an accident

The Cost of Accidents

- The Hanford S-102 high-level waste spill stopped operations for 18 months
- At AMWTP, the failure of waste boxes during retrieval stopped operations for 26 months
- At SRS, a contaminated puncture wound stopped operations for 4 months
- At SPRU, the inadvertent spread of contamination during demolition will delay completion by more than a year

Safety is not opportunity lost,

Safety is opportunity's cost!

Why Major Accidents Occur

Major accidents occur when conditions are ripe:

- Strong budget and production pressures
- Organizational changes that leave functional gaps
- Over-confidence that leads to complacency
- Failure to follow the group's own rules
- *Lack of effective oversight and issues management*
- Acceptance of minimal standards of practice
- Inherent conflicts of interest
- Priorities and rewards favor mission over safety
- Accumulated residual risks erode the safety margin

These are all organizational culture issues!

Organizational Culture is the Key

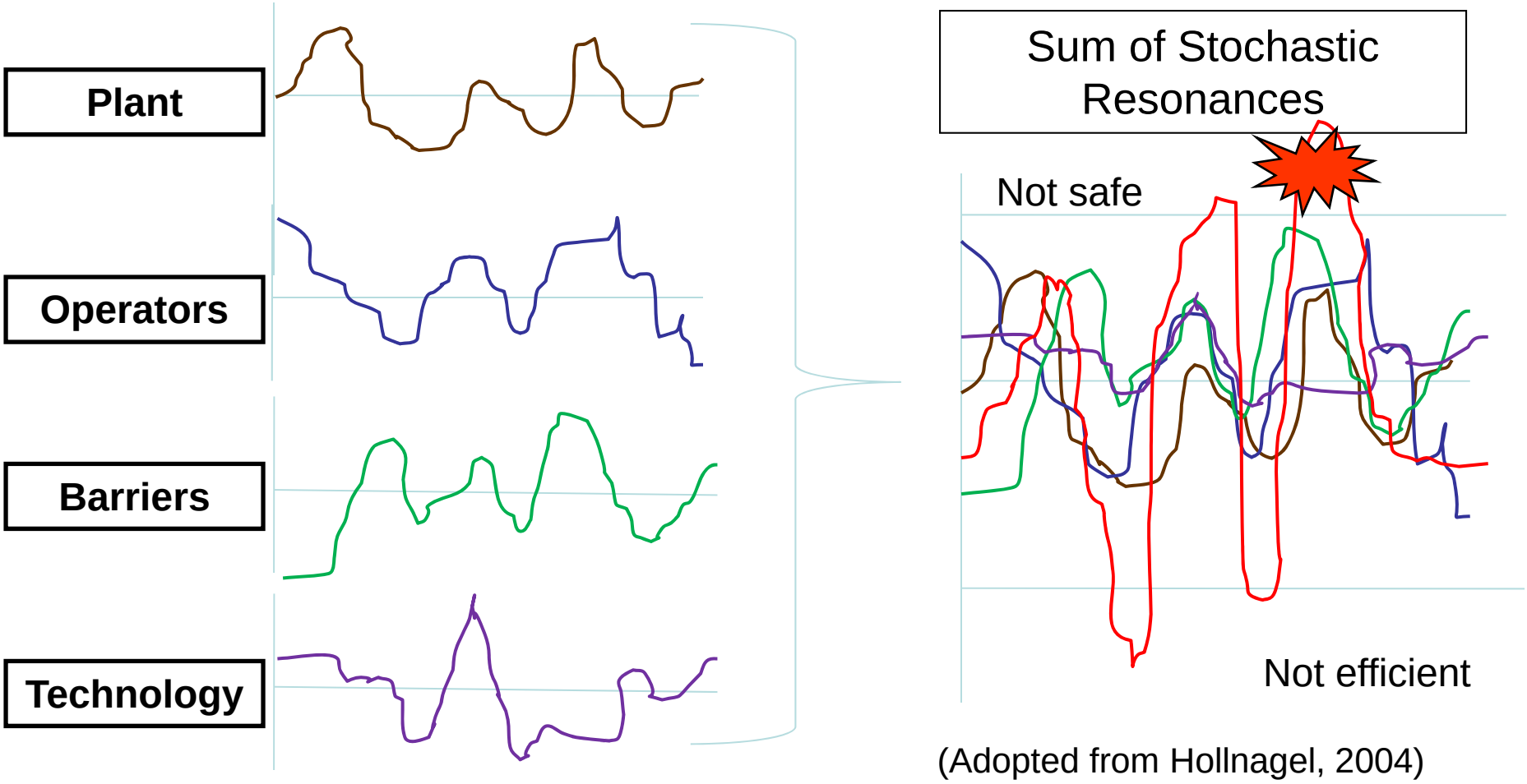
Culture shapes an organization's collective priorities, decisions, behaviors, and attitudes

- The workforce's dependability and reliability
- The level of formality in the conduct of work
- The quality of facility design, analysis, and construction
- The effectiveness of safety systems
- The degree of procedure adherence
- The approach to internal and external safety concerns
- The respect for authority and accountability
- The ability to identify, address, and resolve technical issues

If the culture is right, all becomes easier

Organizational Accident Model

Functional Resonance Accident Model



(Adopted from Hollnagel, 2004)

Robust Safety Culture Benefits

"When decision makers choose a course of action for economic reasons that has the potential to decrease the margins on which we have relied, I think sometimes it may be because they are somewhat removed from the possible implications of that choice.

Organizations that already have – or work to develop – a robust safety culture will be the ones that fully benefit ... And the benefits are not limited to safety."

Chesley B. Sullenberger
Sixth Annual FAA International Aviation Forum
September 10,2009

Why "Only Me"

"The only thing of real importance that leaders do is to create and manage culture…"

– Edgar Schein, MIT

What Leaders Need To Do

1. Understand that DOE has inherently Federal responsibilities that it cannot avoid
   - The contractor "***provides*** adequate protection…"
   - The Federal staff "***ensures*** adequate protection…"
   - DOE delegates **authority** but retains **responsibility**
2. Understand the nature of low-probability, high-consequence accidents
   - Driven by inadequate control of uncertainty, not cause-effect relationships; one needs a different approach to intervention
   - Reduce the variability and increase the reliability and predictability of accident barriers, including humans

What Leaders Need To Do

3. Understand that even one nuclear accident is too much
   - "Risk-informed decision making" can be deceptive; focus on consequences, not on probabilities
   - Learn from others' pain; don't assume "that won't happen here"

4. Recognize the importance of oversight
   - Oversight is your best management tool, use it
   - Failure of oversight is usually cited as a contributor to organizational accidents
   - Overseers need unfettered access and direct contact with senior managers who will listen and act
   - The Board, Facility Representatives, HSS site liaisons, and others provide independent perspectives

What Leaders Need To Do

5. Recognize the value of “boots on the ground”
   - Facility Representatives build bridges between DOE and the contractors
   - Once accepted in workplace, they can observe “work being performed” instead of “work being demonstrated”

6. Encourage the use of appropriate metrics and leading indicators
   - DART & TRC do not tell you about facility or process safety
   - For accident avoidance, create metrics focused on functionality of barriers and mitigation
   - Pair mission-metrics with safety-metrics for trending

What Leaders Need To Do

7. Focus rigorous oversight on process and facility safety
   - Again, oversight is a management tool
   - Overseeing performance-based requirements demands strong technical competency to ensure adequacy of the process
   - A manager should never be surprised by the findings of independent oversight groups
8. Promote the early integration of safety into design
   - The cost of rework and schedule slippage is high
   - Reduces both project risks and operational risks
   - Facilitates a strong design and a robust safety culture

What Leaders Need To Do

9. Embrace a strong set of directives and standards based on decades of experience
   - It is to your advantage for DOE to have a strong set of directives; reduces your margin of risk and liability
   - Organizational learning is fickle and corporate memory is short; makes sure lessons are learned and institutionalized

10. Always focus on balancing mission and safety
   - Safety is an enabler
   - There will always be trade-offs, but make sure safety does not get penalized for success
   - As mission grows and changes, explicitly bring safety along with it; do not assume your safety programs can adjust ad hoc

What Leaders Need To Do

And finally, heed the lessons from recent accidents:

- *DeepWater Horizon* – be sure that barriers, detectors, and emergency equipment will work when called on
- *Fukushima Dai-ichi* – anticipate loss of local infrastructure and support capabilities during major disruptions
- *Costa Concordia* – expect that sooner or later somebody will do the totally unexpected
- *I-35W Bridge* – hidden design faults can haunt you at any time
- *San Bruno* – beware the dangers of an aging infrastructure
- *DC Metro* – cutting maintenance and oversight will not save money

Prepare for the unexpected!

Conclusions

- ***Nothing is more expensive than an accident***
- ***Nuclear events and accidents have disproportionately larger impacts on mission than other major accidents***
- ***Don't "reward" a good safety program by cutting its funding***
- ***Plan for the unexpected***
- ***If the culture is right, all becomes easier***
- ***Leaders are the designers, modelers, and teachers of the organization's culture***

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