

A User's Guide to Preventing Major Accidents

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**2014 Nuclear Facility Safety Programs Workshop
May 7, 2014**

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102 Years Ago



2 Years Ago



3 Weeks Ago



Past 7 Years





Objectives

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



The Cost of Safety

- Ensuring that adequate resources are allocated to safety programs is always difficult – balance (integrate) mission and safety
- Measuring a safety program's effectiveness is also difficult, especially for preventing low probability, high-consequence accidents
- 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; reducing FR's, SSO's, etc. may be penny-wise and pound foolish
- 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
- Hanford – airborne alpha release, 2 workers assigned committed doses; January 2013

Cost of safety is small compared to cost of accident



The Cost of Accidents

- The Hanford S-102 high-level waste spill stopped operations for 18 months
- At INL's AMWTP, the failure of waste boxes during retrieval stopped operations for 26 months
- At SRS F Area, a contaminated puncture wound stopped operations for 4 months
- At SPRU, the inadvertent spread of contamination during demolition has contributed to delayed completion of D&D by more than 3 years
- At WIPP, fire and contamination event has shut down operations for 3 months; need to revise DSA's/TSR's, and hold readiness reviews

***Safety is not opportunity lost,
Safety is opportunity's cost!***



Why Major Accidents Occur

Major accidents occur when conditions are rife with:

- 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!



“Each decision, taken by itself, seemed correct, routine, and indeed, insignificant and unremarkable. Yet in retrospect, the cumulative effect was stunning.” *(Columbia AI Board)*



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 and programs
- The degree of procedure adherence
- The approach to raising and resolving safety concerns
- The respect for authority and accountability
- The ability to identify, address, and resolve technical issues

If the culture is right, the workplace becomes safer



**“The only thing of real importance
that leaders do is to
create and manage culture ...
If you do not manage culture, it manages
you.”**

– Edgar Schein, MIT

What Safety Professionals Need To Do (to prevent accidents)



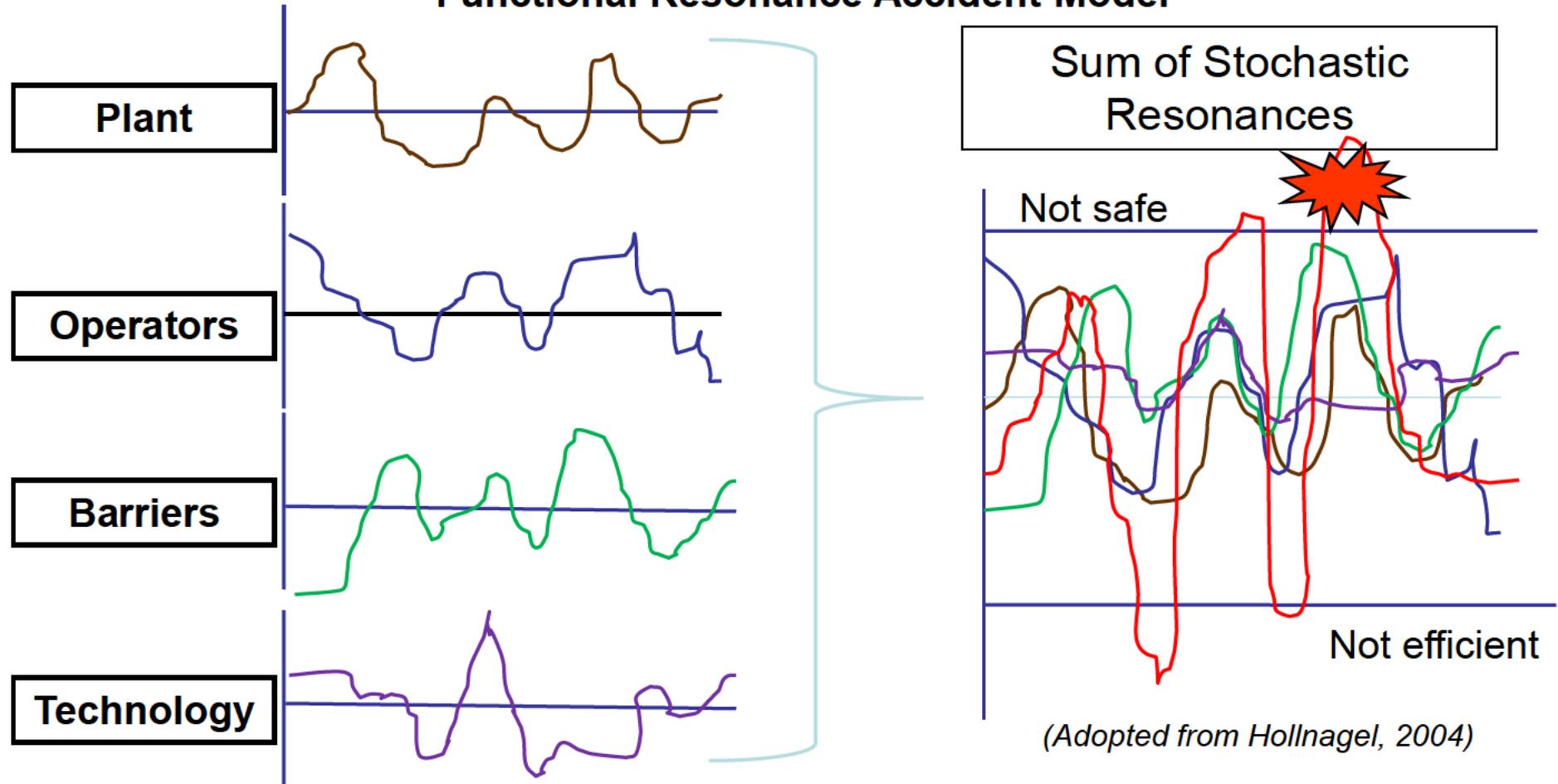
1. Understand that DOE has inherently Federal responsibilities that it cannot avoid
 - The contractor “***provides*** adequate protection...”
 - The DOE staff “***ensures*** adequate protection...”
 - DOE delegates **authority** but retains **responsibility**

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

Organizational Accident Model



Functional Resonance Accident Model



What Safety Professionals Need To Do (cont.)



3. Understand that even one nuclear accident is too many
 - “Risk-informed decision making” can be deceptive; focus on consequences, as well as 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, DOE facility representatives, SSO staff, and others provide independent perspectives

What Safety Professionals Need To Do (cont.)



5. Recognize the value of “boots on the ground”
 - Facility representatives, SSO staff, 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 nuclear, facility, or process safety
 - For accident avoidance, use metrics focused on functionality of barriers and mitigation
 - Pair mission metrics with safety metrics for trending

What Safety Professionals Need To Do (cont.)



7. Focus rigorous oversight on process and facility safety
 - Again, oversight is a management tool
 - Safety oversight demands strong technical competency to ensure adequacy of the process
 - One 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 Safety Professionals Need To Do (cont.)



9. Embrace a strong set of directives and standards based on decades of experience
 - It is advantageous for DOE to have a strong set of directives; reduces the margin of risk and liability
 - Organizational learning is fickle and corporate memory is short; learn and institutionalize lessons

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

What Safety Professionals Need To Do (cont.)



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
- *Texas Fertilizer Plant* – do not assume a record of no major accidents is a justification for not performing federal oversight
- *I-35W Bridge* – hidden design faults can haunt you at any time
- *San Bruno Pipeline* – beware the dangers of an aging infrastructure
- *DC Metro* – cutting maintenance and oversight will not save money

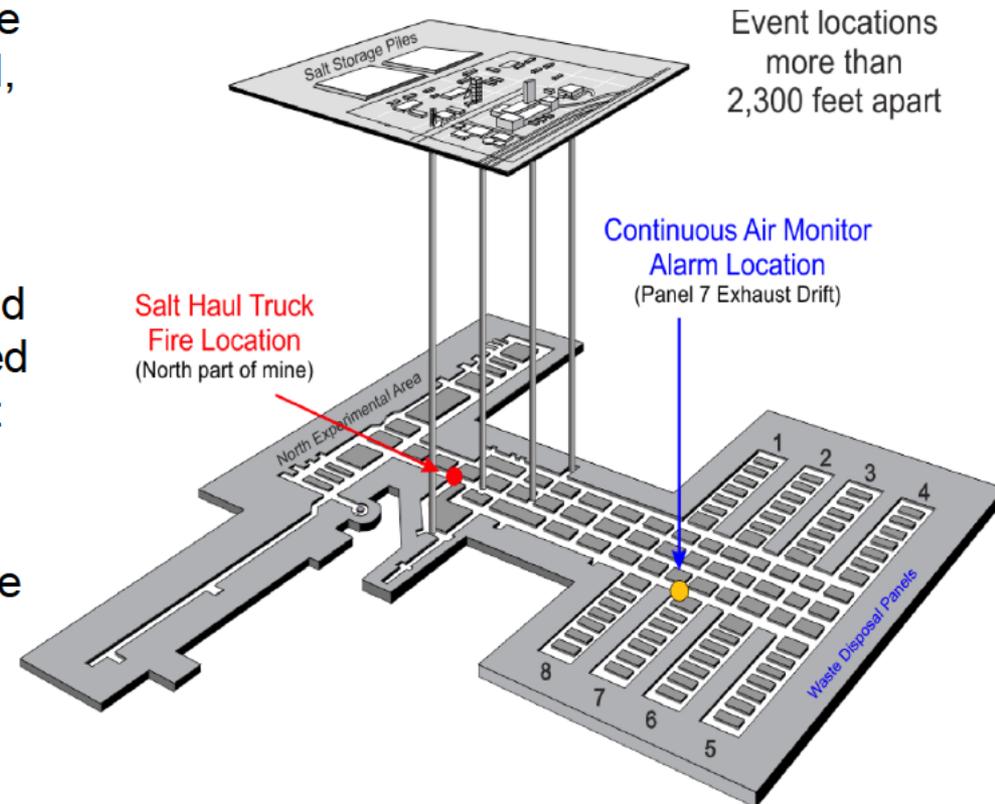
Prepare for the unexpected!

Underground Salt Haul Truck Fire at WIPP



- Salt haul truck caught fire in WIPP underground on February 5, 2014

- Efforts to extinguish the fire were ineffective; mine was evacuated, fire allowed to burn to extinction
- No TRU waste emplacements were underway at the time
- No radioactive materials involved in fire, no contamination released by fire, but several workers sent to hospital for potential smoke inhalation
- Mine rescue teams entered mine later that day and applied fire extinguisher and foam onto smoldering truck



- DOE convened an Accident Investigation Board and deployed it to WIPP
- DNFSB deployed staff to monitor the investigation and recovery efforts

Radioactive Contamination Release at WIPP



- On February 14, 2014, at 11:13 pm, monitoring equipment detected a significant release of radioactive material underground
- No personnel underground at the time, but inspections of the mine and emplaced waste were done earlier that day



- Mine ventilation system automatically shifted to filtered mode to contain release
 - Airborne contamination contained Pu and Am, detected by offsite air monitors
- Bioassay detected contamination in all 13 workers aboveground at WIPP during the event and 4 the next morning (doses to 17 individuals were small)
- WIPP contractor bringing in extensive help from parent company
 - Working to stop ongoing release of low levels of airborne contamination
 - Executing phased reentry into mine to see what happened
- DOE convened another Accident Investigation Board
- DNFSB staff onsite to monitor the investigations and recovery efforts

Emergency Preparedness, Response, & Recovery



- Key topic in recent Board public meetings (Los Alamos, Pantex, Y-12)
- Performance at DOE sites has varied
- DOE assessed the implications of the Fukushima events and issued enterprise-wide guidance, but has not revised its emergency management requirements
- Key areas of Board concern are:
 - Multiple-facility impacts
 - Cascading or “connected” events
 - Loss of utilities and supporting infrastructure
 - Coordination of DOE and local response resources
- Board continues to champion efforts by DOE to improve its response and recovery from natural phenomena events and operational accidents





Readiness to Restart

- Proper implementation of DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*, should result in improvements in the safety of facility startups/restarts and their operation
- Encourage continued investment in training, oversight, and line management involvement
- Conducting a readiness review may be deemed appropriate by DOE or contractor line management officials for any situation



Readiness to Restart

- Contractors should be ready to operate when they commence a readiness review
 - [DOE O 425.1D] “The readiness reviews are not intended to be line management tools to achieve readiness. Rather, the readiness reviews provide an independent verification of readiness to start or restart operations”
- While provisions exist to pause a readiness review for instances where facilities are not ready, this should be the exception
- More often than not, facilities are ready for a readiness review
- Board has noted two instances in the past year where facilities needed to pause the readiness review because they were not ready



Lessons

- Cost of safety is small compared to cost of 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 resources
- Plan for the unexpected
- If the culture is right, the workplace becomes safer
- Leaders are the designers, modelers, and teachers of the organization's culture

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