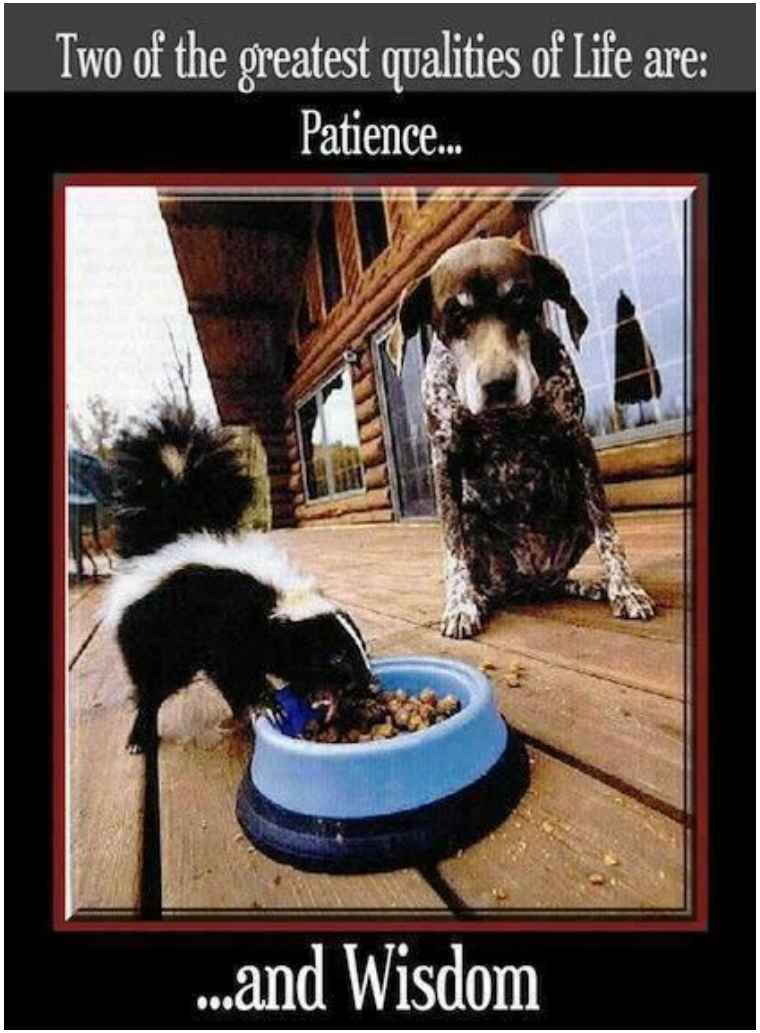
Fire, Seismic, and Other Ex-Process Events and Criticality Safety Risk Acceptance

Shean P. Monahan, Thomas P. McLaughlin, Mark V. Mitchell, and David K. Hayes


Two of the greatest qualities of Life are:
Patience...
...and Wisdom

Listening*

We are unable to talk productively about complex issues because we are unable to listen

- Typical listening patterns are tactical, not relational
  - Viewpoint sifting, mental rehearsing of rebuttals
    - Being an "expert" is a severe impediment to listening & learning
- Consequences
  - Difficult or sensitive issues are suppressed
  - Continuance of uncomfortable, irrational strategies
    - Stalemate and general frustration
    - Whistleblowers become the heroes in many such situations

Solving Tough Problems, An Open Way of Talking, Listening, and Creating New Realities, Adam Kahane, Berrett-Koehler Publishers, Inc. (2004)

Boundaries of ANSI/ANS-8

- ANSI/ANS-8.1 defines a control as a limitation on a parameter
  - Purposeful boundary designed to avoid the infinite loop
    - If a mass limit is a control so is anything that implements it
      - Weighing, MC&A practices, etc.
    - If an implementation measure is a control so are the procedures that require them
    - If a the procedures are a control so are
      - the rules for generating the procedure
      - the qualifications of the people writing the procedures
      - etc.
    - Where does this end?
      - Arbitrary and inconsistent points
      - Driven by personal “comfort levels” rather than safety considerations

Event Boundary

- As in the case of controls, there is an event "boundary"
  - Process evaluations are limited to process conditions
    - Sound formality of operations
      - Conduct of operations
      - Conduct of training
      - Conduct of engineering
      - Conduct of maintenance

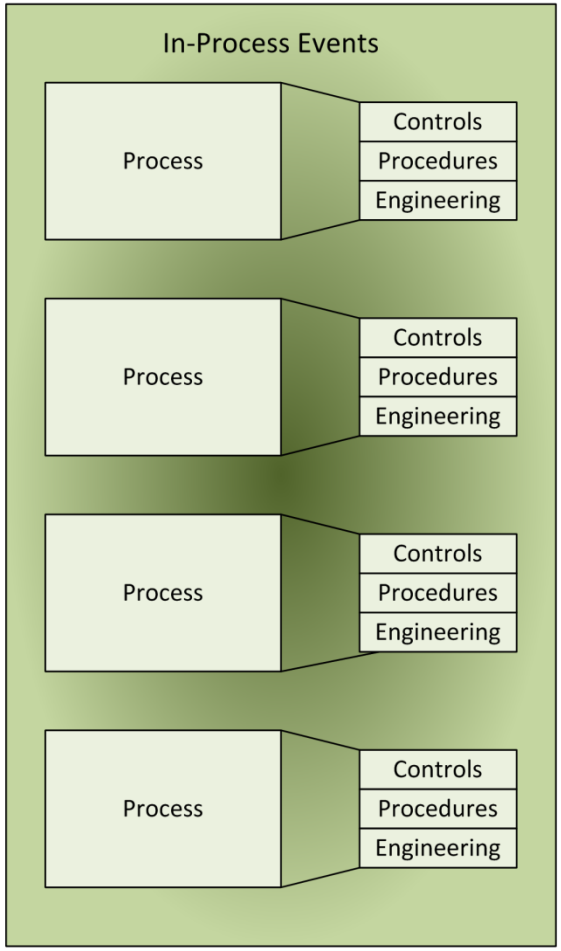
      encompasses process fires as well as the "smaller" acts of nature

- Major ex-process events are relegated to emergency response

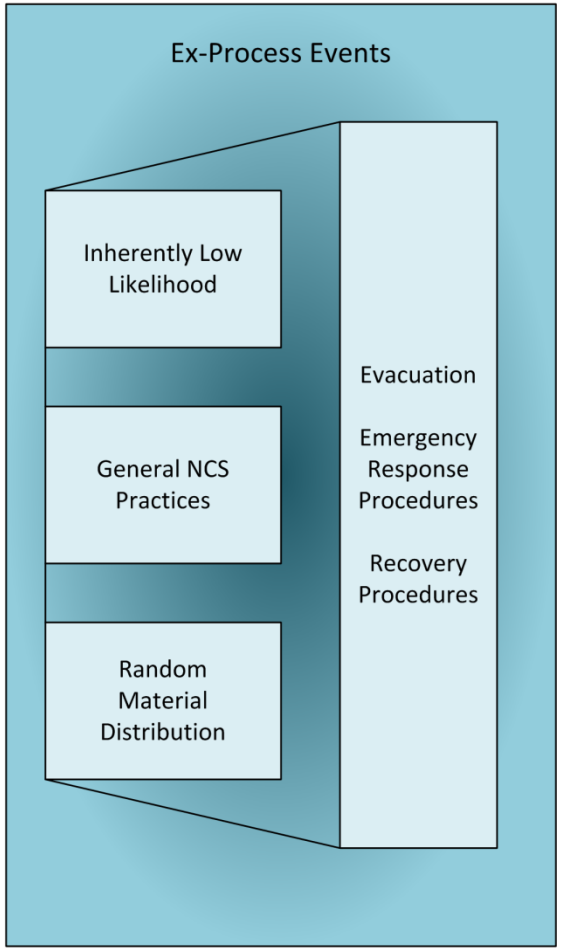
Process Evaluation Scope

- ANSI/ANS-8 standards, with one notable exception, are limited to process conditions
  - …*normal and credible abnormal [process] conditions*
  - …*at least two unlikely, independent, and concurrent changes in process conditions*

- ANSI/ANS-8.7 is the exception that proves the rule
  - …*stored in such a way that accidental nuclear criticality resulting from fire or from flood, earthquake, or other natural calamities is not a concern*.



Process Evaluations



Emergency Response

Major Ex-Process Event Approach

- Criticality accident likelihood was tolerable
  - Event inherently low likelihood
  - Effects are unpredictable and random
    - Probabilities favor low-reactivity material arrangements
      - General NCS Practices
- Consequences were limited by requiring
  - evacuation of operating personnel
  - emergency response and recovery procedures
- Small Likelihood + Consequence Mitigation
  - Acceptable Risk, i.e., **personnel are protected**

Nature of NCS

- General NCS practices already work in favor of low reactivity arrangements
  - Limit operations to amounts of SNM “needed” to accomplish task
  - Containerize material
  - Large scale, unrestrained, staging is poor practice at best
    - Counter to ANSI/ANS-8.7
  - Limited volumes
  - Fixed spacing
  - etc.

Criticality Safety

- *Personnel protection against the consequences of a criticality accident, preferably by prevention of the accident*
  - Theme and purpose of all ANSI/ANS-8 standards
- ANSI/ANS-8.10
  - When personnel are protected by shielding or distance Section 5.1 can be applied
  - *…the number of contingencies may be reduced to unity where the principles of this standard are met*

Planned evacuation of personnel establishes a condition that properly falls under this principle

Low Likelihood Ex-Process Events

- Should be no operations for which the event or response immediately leads to a criticality accident
  - If there are, other measures need to be taken
- Evacuate (protect) operating personnel
- Externally assess the situation using available information and appropriate instrumentation
- Plan and carefully reenter facility
  - Assess as-found conditions
  - Respond accordingly

Isn't all of this going to be done regardless?

Firefighters

- Already accept an increased occupational risk
- Educate them to
  - the possibility of a criticality accident and consequences
  - use techniques to minimize firefighting impacts, e.g.,
    - let glovebox fires burn themselves out
    - spray water (mist/fog) around open staging locations
    - keep a prudent distance from materials
    - proper response to various alarms, including a criticality accident alarm system
  - use tools as aides to their safety
    - include radiation monitoring personnel on teams
    - tag boards at Los Alamos were originally for firefighters
- Morally and legally this needs to be done anyway

Ex-Process Alternatives

1. Address at the process evaluation level
   - Highly judgmental, very conservative and expensive
2. Re-engineer systems to handle events
   - Now and future event revisions (expensive)
3. Accept the low likelihood and mitigate consequences
   - via emergency response and recovery
     - this is going to be done regardless of whether this is formally part of the NCS program
4. Don't process fissionable material
   - destroy existing inventory under one of the three above approaches

Personal Experience

- Addressing ex-process events in process evaluations
  - unsatisfying and discouraging to everyone involved
    - safety personnel contributions are minimized
      - prevent a criticality accident under accident conditions
      - Imagine if…*first time limited diameter tanks were proposed*
  - process personnel feel like "victims"
    - Degrades value and acceptance of all safety provisions as well as formality of operations
      - What good are combustible loading limits if the end result is the same?
      - Why upgrade a glovebox structure if the end result is the same?
      - What good is training if no process benefits are realized?

It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so.

Mark Twain

ANSI/ANS-8 Alternative

- Events need to be handled at the level that is most effective in controlling risk
  - Changes in process conditions are the domain of process evaluations
  - Major ex-process events are the domain of emergency response
- Why doesn't ANSI/ANS-8.1 explicitly say this?
  - It's likely the response would be, *Isn't it already obvious?*
  - Supported by ANSI/ANS-8.1, 8.19, 8.10, and 8.7
    - Nevertheless, ANSI/ANS-8.1 has been encouraged to explicitly draw this boundary

It's All About Perspective

Safety Perspective

"A ship is safe in harbor, but that is not what ships are for."

William Shedd