CSCT Minutes for November 28, 2023

Meeting Attendance		
Attendee		**Present**
M	Arm, Cheryl	
M	Berg, Larry	**X**
EM	Bowen, Doug	**X**
EM	Brady, Mikey	
M	Brooks, Franklin	**X**
M	Bunde, Kermit	
M	Chambers, Angela	**X**
M	Collens, Jake	
M	Damba, Darwin	
M	Dyke, Jimmy	
M	Eberle, Cris	**X**
M	Ellis, Daniel	**X**
M	Fischahs, Christopher	**X**
M	Gilbertson, Sarah	
M	Hahn, Kevin	
	Harglerode, James	**X**
EM	Hayes, David	**X**
S	Henley, Marsha	**X**
M	Hines, Tom	
M	Janson, Stephen	
	Kotzalas , Margaret	**X**
M	Levine, Michael	**X**
M	Ly, Gary	**X**
M	Marenchin, Thomas	
M	Moore, Josiah	**X**
M	Moss, Patrick	
M	Murphy, Katie	
M	O'Donnell, Valentina	**X**
M	Ondara, Johnny	**X**
M	Perry, Christopher	**X**
M	Petraglia, Jeffrey	**X**
	Powell, Tamara	**X**
M	Russell, Paige	
M	Sandgren, Kevin	
M	Thrasher, David	**X**
M	Udenta, Gladys	
M	Vickers, Linda	
M	Wallace, George	**X**
M	Washburn, Peter	
M	Wilson, Robert	**X**
M	Wise, Tammy	**X**

M – Member
EM – Ex-Officio

S – Scribe

Virtual Roll call – For those using Phone-in, please assist roll call and let us know who you are. Thanks!

- December meeting is canceled due to quorum, Next meeting will be the January meeting.

Previous items update:

- No open items

Items for discussion:

- Doug Bowen – ANSI/ANS-8 Process Analysis and Double Contingency Discussion,
  - This information is taught in managers course - Module 7 ANSI/ANS-8 Standard,
  - 22 criticality accident, 16 were the result of human error via Conduct of Operations,
  - Increasing infractions may be a precursor to an accident,
  - Understanding why infractions are occurring is vital,
  - Credible and unlikely are based on the formality of operations,
  - Technical focus should be on ANS 8.1 Section 4.1.2 Process Analysis which is a fundamental requirement and is necessary to meet Section 4.2,
  - Double Contingency Principle is a "should" statement for defense-in-depth and is not a shall requirement.

Open discussion:

- DOE O 420.1D is in RevCom for review,
- if anyone has an implementation plan for DOE 420.1C or D, please send to Cris

Topics for future meetings?

- Doug Bowen – Report on the 2023 NCSP Budget Execution meeting
-

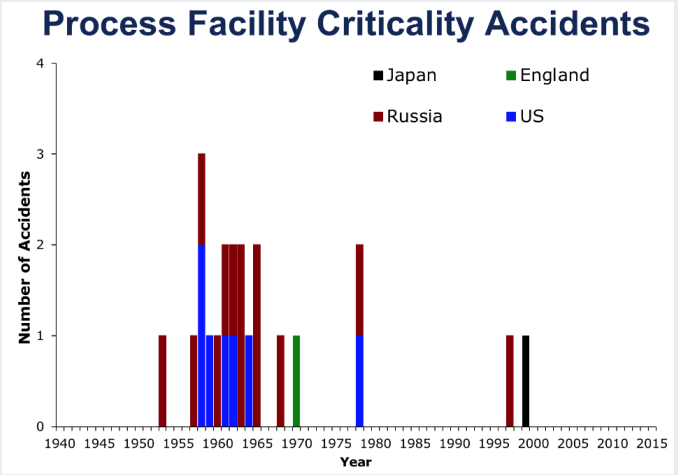
ANSI/ANS-8 Standards and Prerequisites

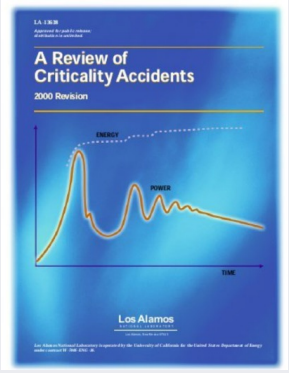
Douglas Bowen, PhD
NCSP Execution Manager
ORNL Section Head – Nuclear Criticality Safety, Nuclear Data and Radiation Transport

November 29, 2023

Process Facility Consequences Summary

- 9 deaths – 2 (US), 2 (JP), 5 (USSR)
- 3 personnel required limb amputations
- Negligible environmental contamination
- No physical damage to equipment or facilities
- Measured public exposures in JP accident only
- Significant accident rate decrease >1964
  - Advent of ANSI/ANS standards
  - Use of more favorable geometry equipment





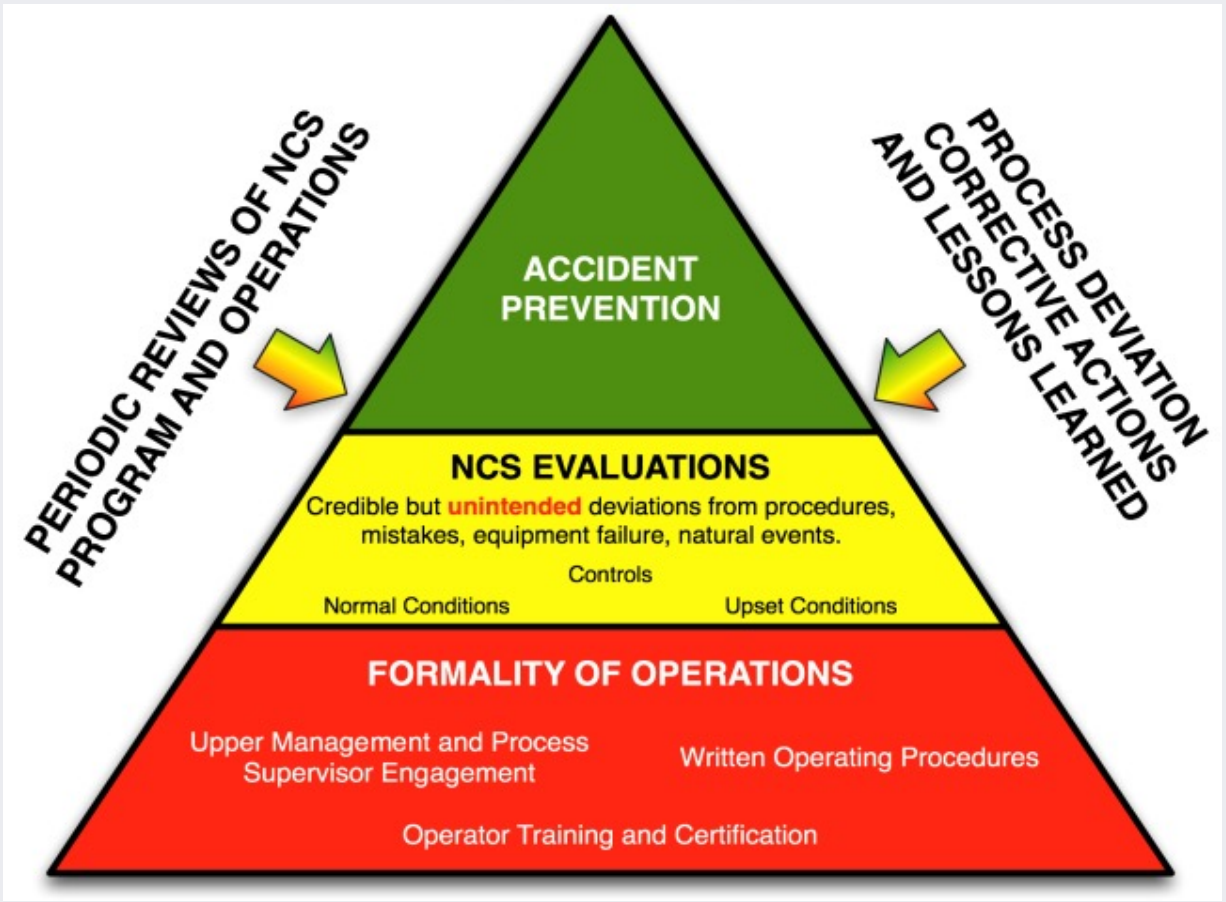
Just another Industrial Safety Hazard: Nuclear Criticality Safety

- **Nuclear Criticality Safety is**

  Personnel protection *from the* ***consequences*** *of a criticality accident, preferably by prevention of the accident*

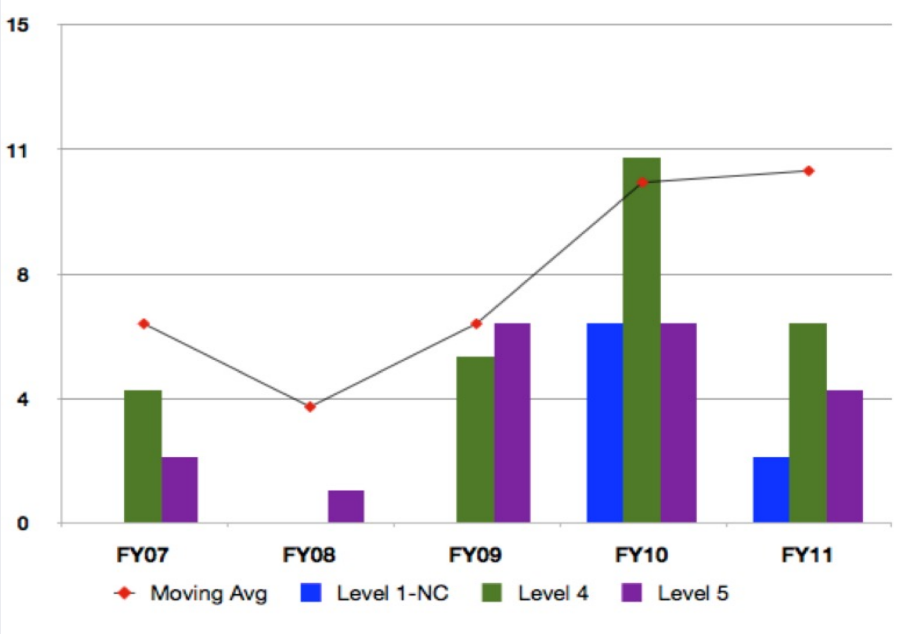
  - Encompasses procedures, training, and other precautions in addition to physical protection
    - "Formality of Operations" or "Conduct of Operations"
- Of the 22 known process criticality accidents,16 involved flawed or faulty Conduct of Operations
  - Importance of written procedures and fissionable material control
  - Abnormal conditions are well understood and effects mitigated
  - Well trained operations staff
    - Don't perform unapproved actions
    - Aware of criticality hazards and empowered to stop work, if necessary
  - Process supervisors should ensure that the operators under their supervision are knowledgeable and capable
  - Senior management should be aware of the hazard of accidental criticality and its consequences

NCS Program Dependencies



Example – Infractions

- Process deviations provide a site the opportunity to improve their FOP and NCS programs
- Site events such as management changes, new staff, increasing NCS program formality, and other issues could shift or degrade the safety culture and formality of operations such that significant events occur at a site (i.e., accidents, NCS infractions, deviations from procedures, etc.)
- Thus, the health of a site FOP is not a constant, i.e., not changing over time, but, instead, varies as a function of time
- Thus, the "…credible abnormal conditions" and "…unlikely changes in process conditions" at a site vary as a function of time as well



Either the safety culture, or formality of operations (or both) should be "fixed" before proceeding with operations

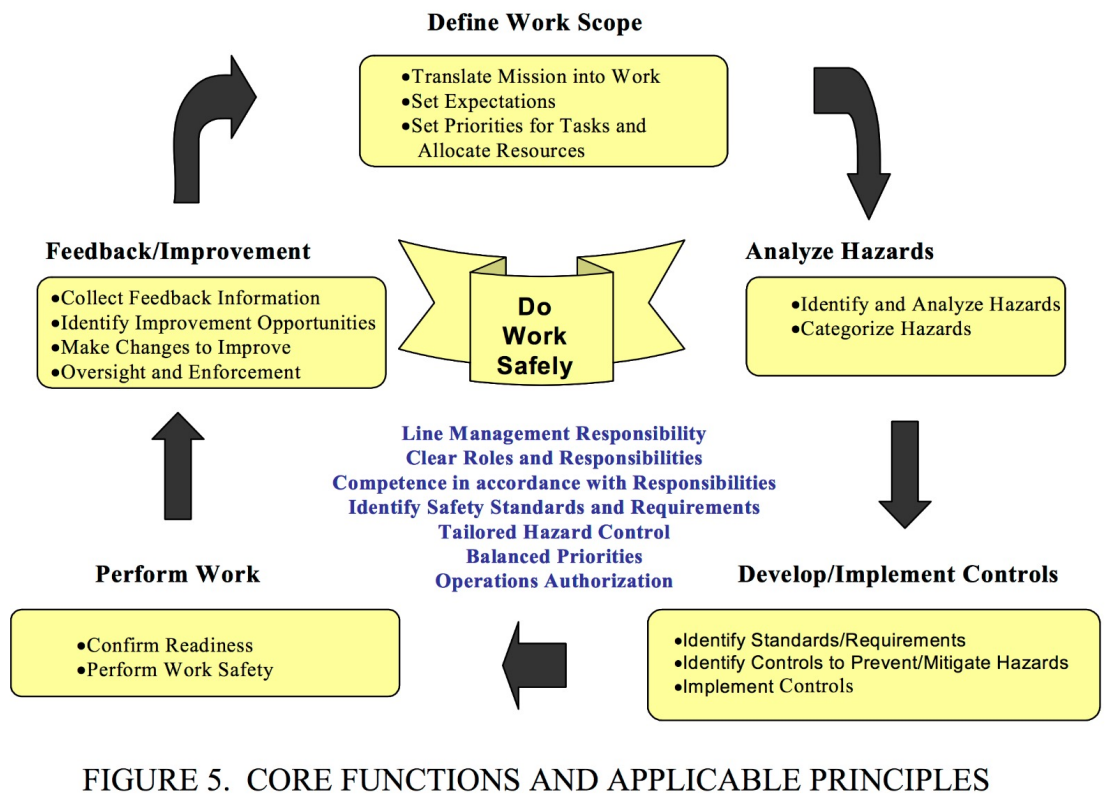


FIGURE 5. CORE FUNCTIONS AND APPLICABLE PRINCIPLES

From the **US DOE Integrated Safety Management Policy**

https://www.energy.gov/em/downloads/integrated-safety-management-policy

Administrative Practices

- Standards have programmatic administrative requirements
  - Applicable for hands-on fissionable material operations
    - ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations With Fissionable Material Outside of Reactors*
    - ANSI/ANS-8.19, *Administrative Practices For Nuclear Criticality Safety*
- ANS-8.1 scope
  - Applicable to operations with fissionable materials outside nuclear reactors, except for the assembly of these materials under controlled conditions, such as in critical experiments.
  - Generalized basic criteria are presented, and limits are specified for some single fissionable units of simple shape containing ^{233}U, ^{235}U, or ^{239}Pu, but not for multiunit arrays.
- ANS-8.19 scope
  - Provides criteria for the administration of an NCS program for operations with fissionable materials outside of nuclear reactors in which there exists a potential for nuclear criticality accidents

ANS-8.1 and ANS-8.19 Content Structure

8.1		8.19
4.1.1 Responsibilities	Responsibilities	**4.0** Management Responsibilities **5.0** Supervisory Responsibilities **6.0** NCS Staff Responsibilities
4.1.2 Process Ananlysis **4.2** Technical Practices	Safety Margin	**7.0** Evaluations for NCS
4.1.3 Written Procedures **4.1.5** Operational Control **4.1.6** Operational Reviews	Conduct of Operations	**8.0** Implementation and maintenance of NCS controls
4.1.4 Materials Controls	Materials Control	**8.0** Implementation & maintenance of NCS controls
4.1.7 Emergency Procedures	Emergency Response	ANSI/ANS-8.23

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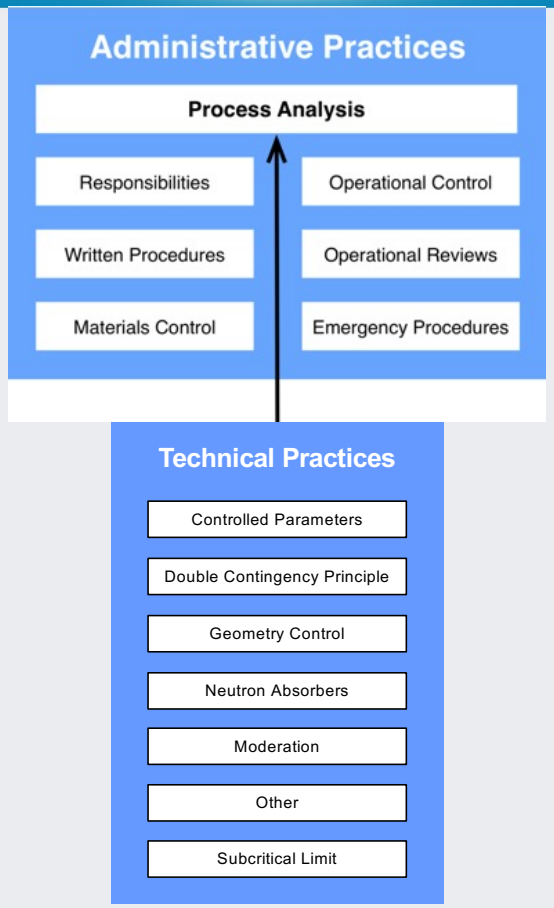
Safety Margin (Ensuring Subcriticality)



Safety Margin (Ensuring Subcriticality)

- Process Analysis Requirement (ANS-8.1, Section 4.1.2)
  - Fundamental program requirement
  - How safe is safe enough
    - Implemented through process evaluation
  - Supplemented by the technical practices section of the standard
- Specifies the goal of the NCS evaluation process and is the purpose of NCS programs
- Directed at management & supervision of operations but with significant support from NCS staff

> ***4.1.2 Process Analysis***
>
> *Before a new operation with fissionable material is begun, or before an existing operation is changed, it **shall** be determined that the entire process will be subcritical under normal and **credible abnormal conditions**.*

Safety Margin – Technical Practices

- **4.2.1 Controlled Parameters**
  - Specify the parameters under control and the limits
  - Understand how variations in these parameters influence the safety margin
- **4.2.2 Double Contingency Principle (DCP)**
  - *Process designs **should** incorporate sufficient factors of safety to require **at least** two unlikely, independent, and concurrent **changes in process conditions** before an accident is **possible***
  - This recommendation cannot be implemented in many cases
    - **Example**: Gaseous diffusion cascade in uranium enrichment plants
  - The principle considers the concept of defense-in-depth because human beings tend to make mistakes
- **4.2.3 Geometry Control**
  - Use dimensional control when practical
  - Prior to use verify validity and dimensions
  - Maintain

Safety Margin – Technical Practices

- **4.2.4 Neutron Absorbers**
  - Maintain effectiveness
  - Extraordinary care should be exercised for soluble poisons
- **4.2.5 Moderation**
  - Reliance may be placed on limiting the moderator content of fissile material processes
- **4.2.6 Other**
  - Reliance may be placed on any controlled parameter that influences k_{eff} either directly or indirectly with preference given to design features rather than administrative control
- **4.2.7 Subcritical Limits**
  - Derive from experiments when applicable data is available
  - May be derived from validated computations
  - Provides single and multi-parameter

As necessary, the ANSI/ANS series standards are referenced to provide further guidance, recommendations, and requirements.

Clarification – Process Analysis and the Double Contingency Principle

ANSI/ANS-8.1 Section 4.1.2

Process Analysis Requirement

- Credible abnormal conditions
  - Similar to *changes in process conditions*
  - Each credible abnormal condition usually affects a single MAGICMERV parameter of the system at a time
    - This can negatively impact the reactivity of the system, i.e., less safe
  - Meaning is broader than changes in process conditions
    - Multiple MAGICMERV parameters can be be affected by a single credible abnormal conditions
      - **THESE ARE SINGLE POINT FAILURES**

ANSI/ANS-8.1 Section 4.2.2

Double Contingency Principle Recommendation

- Changes in process conditions
  - Must be unlikely to occur
  - Each change in process conditions usually affects a single MAGICMERV parameter of the system at a time
    - This can negatively impact the reactivity of the system, i.e., less safe
  - At least two unlikely changes in process conditions are required before a criticality accident is possible
    - A criticality may happen but may not, depending on the situation and magnitude of the change in process conditions
    - An incredible abnormal condition must occur before a criticality accident is possible

**process conditions (def.) – the identifying characteristics of a process that have an effect on Nuclear Criticality Safety (e.g., parameters, environment, and operations). ANSI/ANS-8.1-2014, Section 3.*

***credible abnormal conditions – similar to changes in process conditions except this phrase is intended to have a broader meaning because a credible abnormal condition could involve multiple changes in process conditions at the same time, e.g., forklift impacts a storage array, earthquake resulting in breaking multiple solution tanks, etc. (single point failures)*