

# Your Mission...



and

# Nuclear Criticality Safety



Self Improvement Workshop  
August 3-4, 1999  
Las Vegas, Nevada





## **NCS SELF IMPROVEMENT WORKSHOP AGENDA**

### ***"Your Mission and Nuclear Criticality Safety"***

**Tuesday, August 3, 1999**

08:00 – 08:15	Welcome & Introduction	<i>Mark Williams, DOE EH</i>
08:15 – 09:00	DNFSB	<i>Dr. Herbert J.C. Kouts</i>
09:00 – 09:30	Criticality Accidents Can Still Happen	<i>Tom McLaughlin, UC LANL</i>
09:30 – 10:00	Break	
10:00 – 11:00	Impact of Criticality Safety Programs on the DOE Mission	
10:00 – 10:20	<i>Bob Poe, DOE ORO</i>	
10:20 – 10:40	<i>Pete Knollmeyer, DOE RL</i>	
10:40 – 11:00	<i>Mike Hooper, DOE OAK</i>	
11:00 – 11:30	What's Wrong with Criticality Safety Programs?	<i>Dr. Jerry McKamy, DOE EH</i>
11:30 – 13:00	Lunch	
13:00 – 13:40	An Operations View of Criticality Safety	<i>Dick Raaz, SSOC RFETS</i>
13:40 – 14:20	The Department's Integrated, Cross-Cutting Criticality Safety Program	<i>Roger Dintaman, DOE DP</i>
14:20 – 14:40	What Should the Field Office NCS Program Look Like?	<i>Adolf Garcia, DOE ID</i>
14:40 – 15:10	What Should the Contractor's NCS Program Look Like?	<i>Jim Mincey, LMER ORNL</i> Presented by: <i>Calvin Hopper</i>
15:10 – 15:30	Break	
15:30 – 16:30	Paths Forward – In Progress	
15:30 – 15:50	<i>Margaret Morrow, LMES Y-12</i>	
15:50 – 16:10	<i>Duane Renberger, FDH</i>	
16:10 – 16:30	<i>Dennis Fisher, UC LLNL</i>	
16:30 – 16:45	Wrap Up and Look Ahead	<i>Mel Chew</i>
17:00 – 18:00	Reception	<i>EFCOG</i>

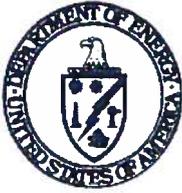
**Wednesday, August 4, 1999**

08:30 – 09:15	DNFSB	<i>Dr. John Mansfield</i>
09:15 – 10:00	A Model for Self-Improvement	<i>Dr. Jerry McKamy</i>
10:00 – 10:30	Break	
10:30 – 11:55	Feedback & Discussion (Panel)	<i>Dennis Fisher, Pete Knollmeyer, Margaret Morrow, Dick Raaz, Frank McCoy, Bob Poe</i>
11:55 – 12:00	Closing Remarks & Adjourn	<i>Mel Chew</i>

*For your convenience, "notes" pages have been provided at the end of each individual presentation*







**The Deputy Secretary of Energy**  
Washington, DC 20585

July 8, 1999

**MEMORANDUM FOR DISTRIBUTION**

**FROM:** T. J. GLAUTHIER   
**SUBJECT:** Nuclear Criticality Safety Self-improvement Initiative

The purpose of this memo is to announce a self-improvement initiative in the highly specialized area of nuclear criticality safety.

During the last few years, Department of Energy (DOE) activities at several sites have been severely hampered by work stoppages resulting from infractions or violations of nuclear criticality safety criteria. The cost of these shutdowns was significant. Beyond cost impacts, some sites have experienced loss of technically qualified and talented nuclear criticality safety staff. This attrition of experienced staff has hampered our ability to recover from these work stoppages. Consequently, I believe that a self-improvement initiative focusing on criticality safety is warranted to facilitate the safe and efficient operation of our facilities. The goal of this initiative is to help ensure that sound criticality safety programs facilitate: (1) continuous improvement in the safety and efficiency of operations, and (2) stability of the criticality safety function. This initiative complements our Defense Nuclear Facilities Safety Board commitments in Recommendation 97-2, and is endorsed by the DOE Nuclear Criticality Safety Program Management Team and the Criticality Safety Support Group, two groups established as part of our implementation plan for Recommendation 97-2.

I have requested that the Office of Environment, Safety and Health (EH) begin the DOE-wide self-improvement initiative by conducting a criticality safety workshop for senior field office and contractor line management. The Energy Facility Contractors Group, whose mission is to promote excellence in all aspects of the operation, management, and integration of DOE facilities, has endorsed the workshop and will participate in it. This workshop will provide managers with lessons learned from these work stoppages and tools to facilitate continuous improvement.

I am asking each of you to send your cognizant senior executive(s) to this workshop and to participate in the initiative. The workshop will play an important role in defining both the self-improvement initiative and our criticality safety program. We expect that workshop "action items" will be factored into your Integrated Safety Management System and implemented as part of that system. EH will contact you regarding the details of the workshop. Questions should be directed to Dr. Jerry McKamy at (301) 903-8031.

Thank you for your cooperation and support in this self-improvement initiative.







# Workshop Overview



Mark Williams

DOE – EH

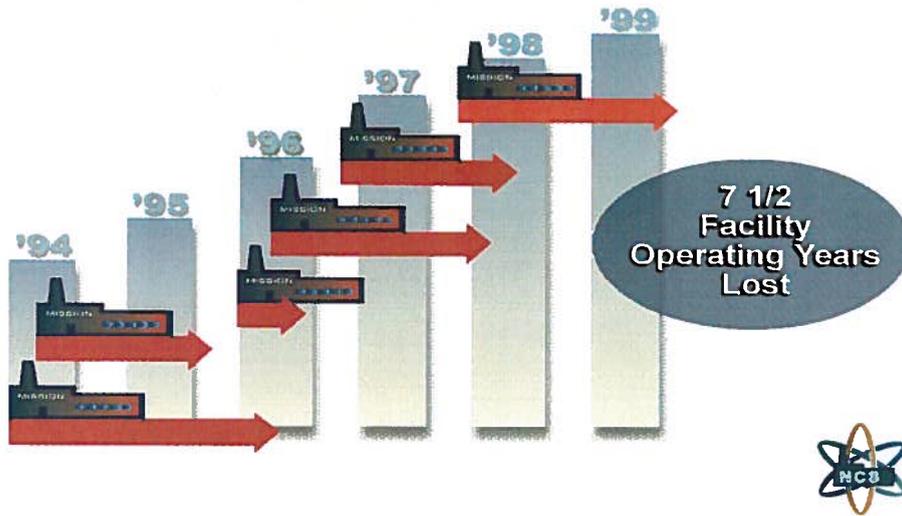
Williams 1

## The NCS Program



Williams 2

## NCS Related Stand-Downs 1994-1999



Williams 3

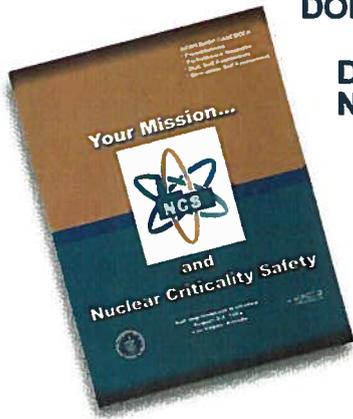
## Goals of NCS Improvement Initiative



- Self Improvement
- Continuous Improvement in the Safety and Efficiency of Operations
- Stability of the Criticality Safety Function
- Actions to Incorporate Into an Integrated Safety Management System

Williams 4

# Self Improvement



**DOE and Defense Board Perspectives**

**DOE and Contractor Perspectives on  
NCS Program Elements**

**Current NCS Program Improvements  
Underway at Some Sites**

**Model for Self Improvement  
and Panel Discussion**

**Formula for Self Improvement**





# NOTES

Dr. Kouts - DNFSB Staff looking at config control of all codes used by DOE. No trail exists from conception to present use. DNFSB has not yet looked at criticality codes.











# Criticality Accidents Can Still Happen



Thomas P. McLaughlin

Group Leader, NCS  
UC LANL

McLaughlin 1

## Lessons Learned from Los Alamos Accident

- No known supervisory or management failures
- Extra care is appropriate when working with both aqueous and organic streams
- Favorable geometry tanks would have prevented the accident
- The one-year old Laboratory NCSC had recommended:
  - A bank of pencil tanks replace the accident tank before the next year-end inventory
  - A criticality alarm system be installed the coming year
- Neutron surveys of tanks and piping were instituted

McLaughlin 2



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## Lessons Learned from Wood River Junction Accident

- There had been no regulatory audit of the plant between start-up and the accident, 131 days later
- License requirements were not followed
  - “No uranium will be used in the  $\text{Na}_2\text{CO}_3$  wash tank”
  - The scrap recovery operation on TCE wash solutions was without the license-required procedures and AEC approval
  - The superintendent did not regularly review the supervisors’ or operators’ logs
- Plant requirements were not being followed
  - The supervisors failed to inform the superintendent of the change in procedure to wash TCE in the  $\text{Na}_2\text{CO}_3$  tank
  - The supervisors failed to enforce labeling requirements
  - The operators failed to follow labeling requirements

McLaughlin 3



## Definition of Criticality Safety (LA-11627-MS)

- Protection from the consequences of a criticality accident, preferably by prevention of the accident
- Encompasses analysis, procedures, training, and other precautions in addition to physical protection
- “The art of avoiding an accidental nuclear excursion”
  - No single failure accidents

McLaughlin 4



## What is a Criticality Accident? (LA-11627-MS)\*

- The release of energy as a result of accidentally producing a divergent fission chain reaction

\* LA-11627-MS, Glossary of Nuclear Criticality Terms, H.C. Paxton, 1989

McLaughlin 5



## Categories of Criticality Accidents

### Critical Assemblies/ Reactor Experiments

~ 50,000 Experiments

~30 Accidents total

14 Fatalities

### Process Line

21 Accidents

20 Solution; 1 Metal

13 Russia; 7 U.S.; 1 U.K.

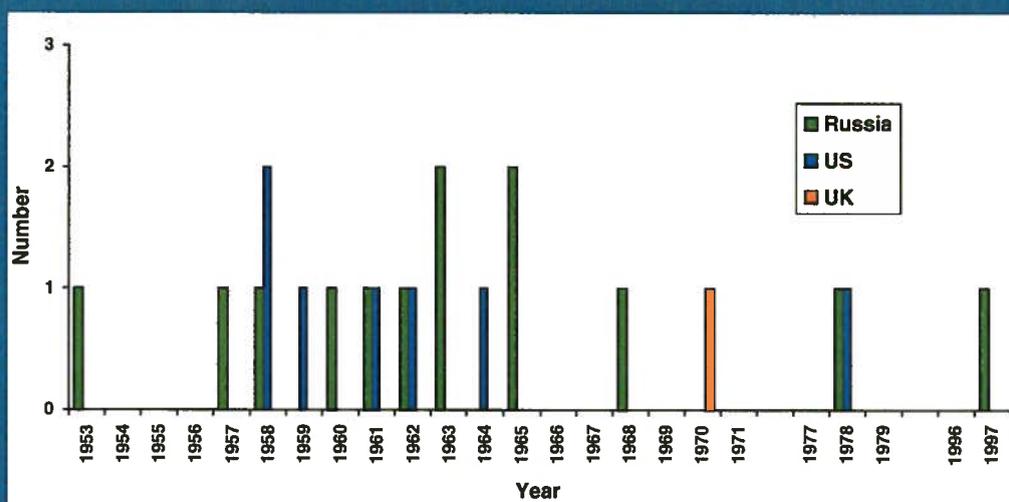
7 Fatalities

McLaughlin 6



## Process Criticality Accidents

20 Involved SNM in Solution, 1 Involved SNM Metal



Note: Last U.S. Accident - 1978



McLaughlin 7

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## Process Criticality Accidents

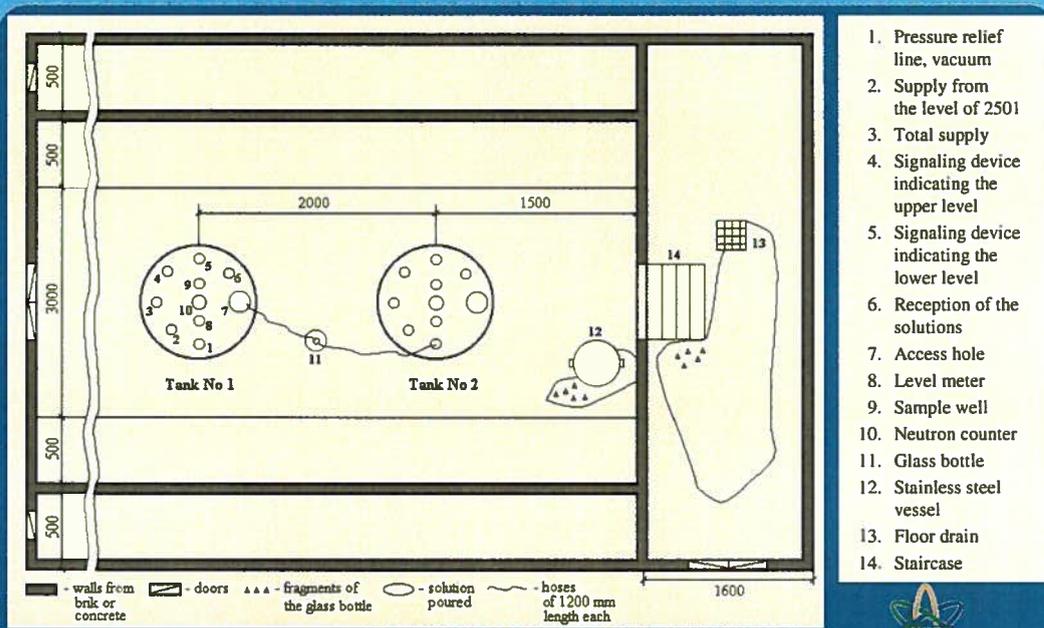
- 20 of 21 involved solutions
- Worker Fatalities = 7
- Public Exposures = Negligible Risk
- Environmental Contamination = Negligible



McLaughlin 8

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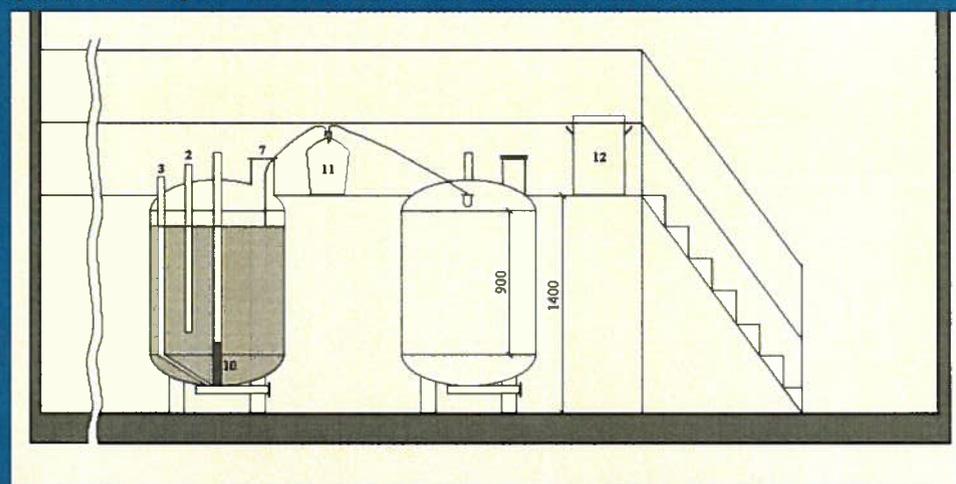
## Schematic of Russian Accident #11



McLaughlin 9

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## Schematic of Russian Accident #11 (Continued)



$\sim 1.4 \times 10^{17}$  fissions  
 ( $3 \times 10^{16}$ ,  $1 \times 10^{16}$ ,  $1 \times 10^{17}$ )

1 Fatality

$\sim 1$  kg Pu recovered

1 Significant Exposure

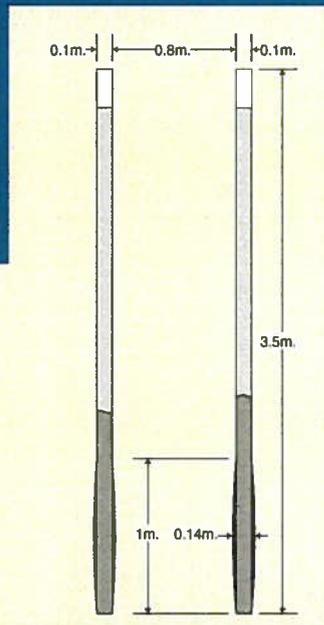
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## Schematic of Russian Accident #13

- $\sim 5.5 \times 10^{15}$  fissions in 6 mild power oscillations over 27 hrs
- Insignificant exposures
- Total U(90) recovered = 24kg

- U crust (~2 g/cc)
- $\text{UO}_2$  particles/water/alkali/nitrite slurry (unknown U concentration)
- Water/alkali/nitrate mixture (<1.0 g/l)
- Void



McLaughlin 11

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## Observations (simple facts) and Lessons Learned (information valuable to future operations) from Criticality Accidents

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## Observations

- Accident frequency  $\approx$  one per year (1953–1965)
- Accident frequency  $\approx$  one per ten years (after 1965)
- No accidents in storage or transportation
- No significant radiation effects beyond facility
- Accidents in shielded facilities have resulted in significant personnel exposures. The appropriateness of emergency evacuation should be considered
- Most accidents have occurred on Mondays, Fridays or the days before or after a holiday shutdown

Not

McLaughlin 13

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## Lessons Learned

- Maximize use of favorable geometry equipment
  - Less reliance on administrative controls
- Poison unfavorable geometry equipment if fissile accumulation credible
  - Raschig rings in pits and sumps, etc.
- Human factors important to all accidents
  - Operators must understand the importance of procedures
  - Operators must understand “the criticality hazard”
  - Procedures must be effective and followed
  - Communications must be unambiguous, generally written
  - Supervisory involvement

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## Lessons Learned (Operations)

- Thorough process understanding is essential for accident prevention
  - Criticality staff must work with process personnel to understand and evaluate credible process upsets
  - Several accidents have resulted from inadequate awareness and consideration of process upsets
- Accurate fissile mass accounting is essential
  - Criticality safety and accountability are complementary
  - Several accidents have been a direct result of inaccurate fissile mass knowledge
- Solution chemistry, particularly involving organic reagents must be thoroughly considered
  - i.e., 2R.F., 2U.S., and U.K. or 25% of all solution accidents

McLaughlin 15



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## Lessons Learned (Operations) (Continued)

- Criticality alarms (and evacuation procedures) should be thoroughly considered/evaluated
  - Multiple excursions are likely
- Reentry must be carefully considered
  - Deactivation of an alarm system must be carefully planned
  - One fatality and two significant exposures from inappropriate actions
  - Remote radiation readouts should be considered
- **No Single Failure Accidents**
  - *“the art of accident prevention”*

McLaughlin 16



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## Lessons Learned (Management)

- Process supervision must be confident of the knowledge, capabilities, and conscientiousness of those they supervise
  - Several accidents might have been avoided or the consequences lessened
  - “When was the last time I saw the job being performed properly?”
  - Mentoring and OJT are essential; lead by example
- Senior management must be aware of the hazard of accidental criticality and its consequences and must assign responsibility clearly and provide general guidance
  - Difficult cost-risk-benefit decisions must be made
  - Production pressures and timetables will exist
  - Accidents led to the creation of the criticality safety specialist

McLaughlin 17



## Lessons Learned (Regulations)

- Regulations must exist which promote safe and efficient operations
  - Early critical experiments learned from '45 and '46 accidents
  - Some experimenters recognized the need for safety guidance for process operations
    - » LA-2036 (1956), TID-7028 (3 editions, 1957, 1961, 1978),
    - » LA-12808 (1996) “The Nuclear Criticality Safety Guide”
  - American National Standards, 1964
  - Only one accident in US since 1964
- Company policies must be clear in expectations and lines of responsibility. Err on the side of learning more, not punishing more
- Operating procedures and postings must be clear, easy to follow, unambiguous, and easy to change

McLaughlin 18



Experiments

## Lessons Learned (Regulators)

- Regulators, like company management, must be confident of the knowledge, capabilities, and conscientiousness of those they regulate
  - Accident prevention rests first and foremost with those directly in charge
  - Regulators must be aware of the operations being performed
  - Regulators should ask themselves “when was the last time I saw the job being done properly?” or “when was the last time I asked this of plant supervisors?”
    - » Slab tanks involved in 1997 accident had not been reviewed by regulatory authorities since put in use in 1984
    - » Wood River Junction

McLaughlin 19



## Summary

- Current accident rate is admirable, but “criticality accidents are not dinosaurs”
  - Past efforts by criticality staff and line management have resulted in the current, low accident rate
- DOE complex is in a one-of-a-kind mode for the future
  - Increased diligence in understanding upset conditions i.e., need for even better communications between operations staff and criticality staff
  - Increased efforts to retain experienced personnel
  - Increased efforts to develop (and retain) new personnel in all parts of the system: criticality staff, line operations, senior management and regulatory personnel
- ***“It Can Still Happen”***

McLaughlin 20















# Impact of Criticality Safety Programs on the DOE Mission Y-12 Plant



Bob Poe  
DOE - ORO

RICHARDSON 1

## Background

- DNFSB Recommendation 94-4 Incident
- Impacts and improvements
- Ongoing efforts
- Summary

RICHARDSON 2



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## Y-12 Plant: Sept. 22, 1994

- Incident location: Y-12 Plant, Building 9204-2E (Beta-2E) storage vault
- Incident scenario: stacking and placement of containers outside Criticality Safety Approval specification

RICHARDSON 3



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## 94-4 Incident Drums from Beta-2E

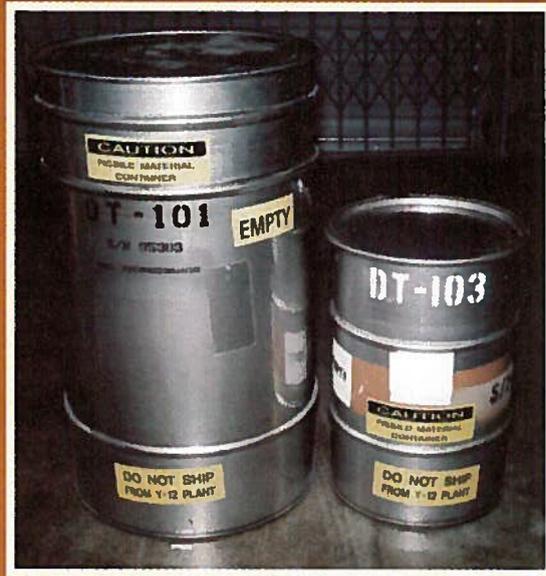


RICHARDSON 4



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## 94-4 Incident Drums from Beta-2E



RICHARDSON 5



## Y-12 Plant: Sept. 22, 1994 (Continued)

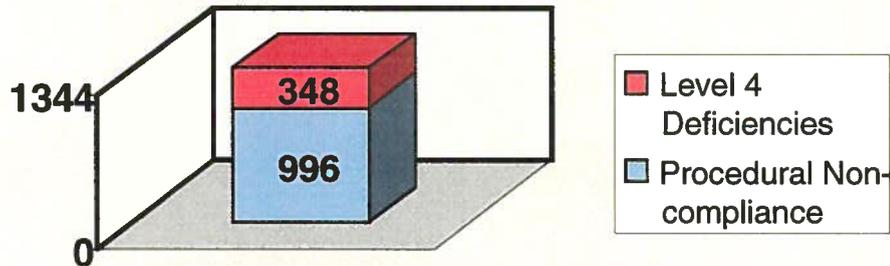
- Required response:
  - Back off 15 feet,
  - Prevent re-entry
  - Notify NCS staff.
- Actual response:
  - Management delayed and argued
  - Re-entry not prevented
  - Delayed NCS staff response
- Immediate actions included:
  - Contractor initiated stand-down of operations and walkdown of all criticality safety approvals

RICHARDSON 6



## CSA Walkdown Summary

### CSA Walkdown Nonconformance Summary - September 1994



RICHARDSON 7



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## DNFSB Recommendation 94-4

- Issued September 27, 1994
- Several tasks developed as corrective actions including multiple assessments of the Criticality Safety program, training, and conduct of operations
- Recommendation 94-4 closed March 12, 1999

RICHARDSON 8



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## National Mission Requirements Met

- During stand-down, all weapons hardware delivery requirements were met via special operations packages:
  - Weapon Receipts
  - Brookhaven Fuel Shipment
  - IAEA Inspections
  - HIFR Fuel Shipments
  - Project Sapphire

RICHARDSON 9



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## Y-12 Restart Progress

- Receipt, shipping, & storage - 1 year
- Depleted uranium - 1 year
- Quality evaluation - 1½ years
- Disassembly & Special Operations - 1½ years
- Enriched U Phase A processes - 4 years
- Enriched U Phase B, etc. - still down

RICHARDSON 10



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## Y-12 Stand-down Impacts

- Large backlog of in-process materials
- Complete inventory has not been performed in 4 years
- Weapons refurbishment program delays



RICHARDSON 11

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## DOE Staffing Impacts

- Increases required:
  - YSO Restart Team established 1994 - staffed with 4 DOE and 15 support service contract employees
  - FACREPs increased from 2 to 7
  - Added Criticality Safety Engineer, Health Physicist, Safety Basis Engineer, and other professionals to ES&H and Program Management Branches



RICHARDSON 12

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## Y-12 Improvements

- Closure of 94-4 action items
- Five major restart efforts completed to date, with NCS program and conduct of operations improvements cited in most recent Phase A restart and DOE HQ reviews
- Increased formality of operations and passive design feature upgrades for criticality safety
- Leadership in ISM implementation

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## Ongoing Efforts

- Initiated fissile material inventory for EUO
- Final EUO resumption efforts underway
- Resolution of in-process material backlog following full restart
- Continued conduct of operations improvements
- ISMS implementation
  - Operational Safety Board's and plant configuration management in place and functioning

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## Ongoing Efforts (Continued)

- Criticality Safety program upgrades
  - Long term improvement plan
  - NCS qualification program
  - Criticality Safety Approval & Criticality Safety Requirement enhancements
- Authorization basis upgrades (including NCS interfaces)
- ISM verification and validation completed
  - Corrective actions being completed



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## Summary

- Major improvements
  - Criticality Safety & authorization basis improvements
  - Conduct of operations (manual issued)
  - Monthly DOE assessment program
  - Culture change (transition from expert based to standards based operations)
- Significant staffing increases
  - DOE and contractor
- Compensatory measures developed
  - Special operations packages allowed critical work to progress



RICHARDSON 16

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# Turning It from Red to Green: Criticality Safety at Hanford's Plutonium Finishing Plant (PFP)

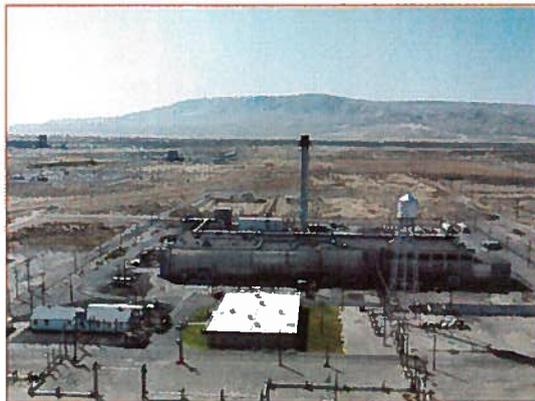
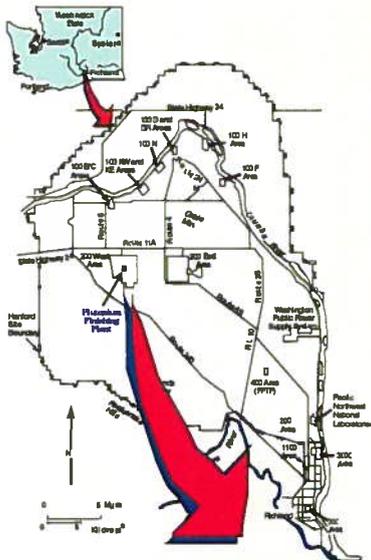


Pete Knollmeyer

Assistant Manager for Facility Transition  
DOE - RL

KNOLLMEYER 1

## The Hanford Site



KNOLLMEYER 2

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## Background

- Hanford and PFP
- NCS program dispersion (94-95 audits)
- M&O to M&I change

KNOLLMEYER 3



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## Hold on Plutonium Stabilization Operations

- Multiple infractions (Dec. 31, 1996)
  - Fixed array wagon moved without the restraints properly secured
  - Wagon placed against non-isolating wall
  - Container with hood waste placed near the wagon without proper spacing
- Two-year hold on fissile material move
  - Mission and DNFSB 94-1 implementation impact
  - Approximately \$170 million

KNOLLMEYER 4



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## Infraction Postings at PFP



KNOLLMEYER 5



Self Improvement Workshop

## Infraction Postings at PFP



KNOLLMEYER 6



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## Initial Corrective Actions

- Management leadership in monitoring NCS program implementation and taking corrective actions
- Employee involvement in identifying problems and assisting co-workers
- Hazard identification and control
- Training to recognize hazards

KNOLLMEYER 7



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## Further Problems

- Incident on Nov. 20, 1997
  - Item labeled H/X<20 placed in wagon posted for H/X<2
  - Vault Ops Manager and Criticality Safety Representative tried to explain away CPS non-conformance
  - Little appreciation of implications
- RL decision - invite EH specialist team to augment restart evaluation and to review Criticality Safety program

KNOLLMEYER 8



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## DOE/EH Review (Dec. 97)

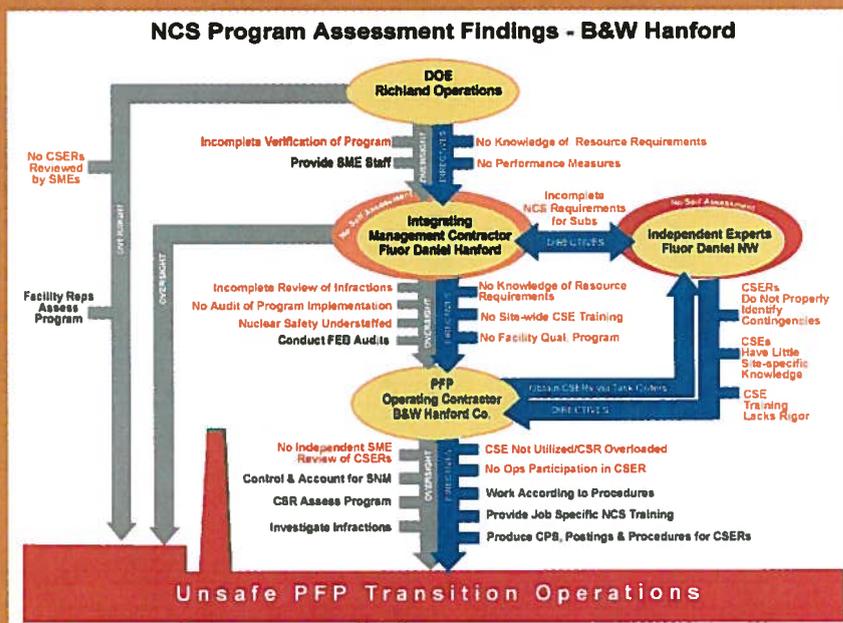
- Reconnect Criticality Safety Engineers with PFP
- Implement graded infraction program
- Adopt best practices for pre-job briefs
- Revise Criticality Safety Evaluation Report/Criticality Prevention Specifications (vault ops) - eliminate overly conservative controls
- RL should increase Criticality Safety support to PFP



KNOLLMEYER 9

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## NCS Program Assessment Findings – B&W Hanford



KNOLLMEYER 10

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## Assessment Concerns - DOE-RL

- Did not provide NCS performance measures to contractor
- Did not regularly review Criticality Safety Evaluation Reports; incomplete verification program
- Did not maintain knowledge of NCS program budget requirements



KNOLLMEYER 11

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## Assessment Concerns - M&I Contractor (FDH)

- No centralized NCS function with Subject Matter Experts to oversee subcontractor programs
- No contract language requiring trained and qualified Criticality Safety Engineers familiar with facility
- Inadequate resources to define a proper NCS program
- No self-assessment



KNOLLMEYER 12

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## Assessment Concerns - Operating Contractor (BWHC)

- Criticality Safety Engineer not utilized and Criticality Safety Rep overloaded
- No operations participation in CSER development
- No independent SME review of CSERs

KNOLLMEYER 13



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## Assessment Concerns - CSE Support Org (FDNW)

- CSERs did not properly identify contingencies
- Criticality Safety Engineers had little PFP-specific knowledge
- Criticality Safety Engineer training lacked rigor
- No self-assessment

KNOLLMEYER 14



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## Overall Corrective Actions

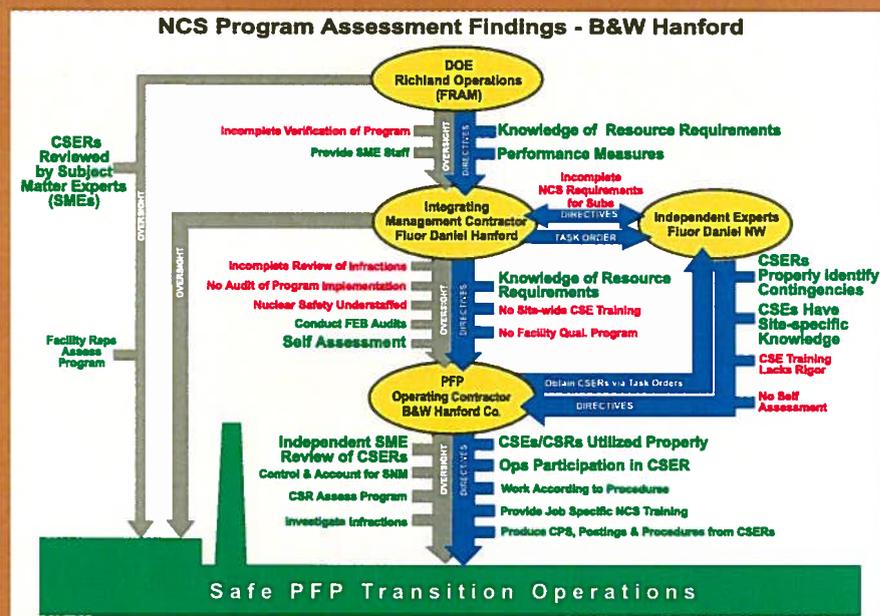
- Additional expertise and resources
- Independent CSER reviews
- Facility-specific training to Criticality Safety Engineers
- Full utilization of Criticality Safety Engineers and Criticality Safety Representatives
- Performance measures
- RL draft directive on NCS program



KNOLLMEYER 15

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## NCS Program Progress – B&W Hanford



KNOLLMEYER 16

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## In Retrospect

Recovering from several ISM failures

- Lack of management ownership
- Lack of definition of roles (NCS support)
- Inadequate training and qualifications
- Unbalanced priorities and resources
- Inadequate use of standards and controls
- Lack of operational discipline/readiness



KNOLLMEYER 17

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## Positive Trends

- PFP successfully cleared ORR with positive finding in Criticality Safety
- Performance measures for PFP indicate solid progress
- Self-identification of problems; involvement of Criticality Safety Engineer and operations staff
- ISMS implementation (PFP - 9/99)



KNOLLMEYER 18

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## Summary

- PFP problems: an urgent wake-up call
- EH assistance for self-assessment has been invaluable
- Visible progress at PFP; slow progress on site-wide issues
- Lessons are important to the DOE complex, and perhaps to civilian nuclear material facilities as well















# Impact of Criticality Safety Programs on the DOE Mission



Mike Hooper  
DOE - OAK

HOOPER 1

## LLNL Mission Impact

- At LLNL, Criticality Safety infractions impacted the Pu Disposition Mission and the Sub-critical Experiments Mission

HOOPER 2



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## Criticality Safety Infractions at LLNL - May 20 to July 15, 1997

- Plutonium handlers violated Criticality Safety controls for mass limits 12 times.  
Examples of these infractions were:
  - Putting a combination of smaller Pu parts and 2 large “hemies” in same glovebox in violation of procedures
    - » (This control was to prevent accidentally “filling” a hemie with smaller plutonium parts)

HOOPER 3



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## Criticality Safety Infractions at LLNL - May 20 to July 15, 1997 (Continued)

- Neglected weight of cladding, resulting in “overmass” of glovebox
  - » (Operators should have taken cladding into account because it “reflects” neutrons back into the plutonium)
- One operator realized mistake on his way home but failed to immediately notify anyone
- Fortunately, the operation still met the criteria for “Double Contingency” - 2 additional unlikely events would have been necessary for a criticality to have even been possible

HOOPER 4



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## Criticality Safety Infractions at LLNL – October 1997

- Operators transferred special nuclear material to the vault that violated criticality controls for the vault locations they were put in
  - Again, operators neglected the weight of the cladding
    - » Operators did not tell the receiving vault personnel that components had cladding, so the vault personnel were unaware of the need to take it into account
- Promptly self-reported to OAK (same day)
- Subsequent investigation identified an additional 10 criticality safety infractions in the vaults



HOOPER 5

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## Root Causes of LLNL Infractions

- Line management responsibility for safety not clearly assigned or understood
- Oversight of Criticality Safety inadequate
- Training was not effective
- Personnel response inadequate (Operator realized problem but did not take action)
- Lack of procedures for movement of SNM
- Overly complex Criticality Safety controls
- Poor communications between personnel



HOOPER 6

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## Price Anderson Amendment Act (PAAA) Notice of Violation

- Summary of EH's findings:
  - Multiple and recurring failures to follow requirements
  - Personnel not familiar with current procedures
  - Ineffective internal oversight
- The Enforcement Action:
  - Classified by EH as Severity Level II problems
  - \$153,750 in fines (waived - UC is a not for profit contractor)



HOOPER 7

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## Impacts at the LLNL Site

- Delayed preparations for LLNL subcritical tests at NTS
- The FY98 Performance Agreement with the President committed DOE to 3 to 4 subcritical tests in FY98
  - LLNL delivered two (HOLOG & BAGPIPE)
- Work accomplished during resumption process through the use of compensatory measures
  - Extremely conservative controls
  - Work accomplished “under a microscope”
  - \$2M in additional costs



HOOPER 8

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## Impacts at the LLNL Site (Continued)

- Delayed development of methodologies for Pit disassembly and Pu stabilization
  - Delays impacted development of Pit Disassembly and Conversion facilities.
  - One year time delay
  - \$3M cost to Lab
  - Over \$10M to programs because technology was not available on schedule
- Compensatory criticality controls were very conservative resulting in slowed progress once work resumed



HOOPER 9

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## Impacts at the LLNL Site (Continued)

- Delays in ISMS
  - Key personnel needed to implement ISMS were working on Plutonium Facility Resumption process
- Delays in required MC&A inventories
  - Made worse by recent safeguards and security concerns.
- Changes to LLNL management of B332 and superblock



HOOPER 10

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## Actions to Fix Criticality Safety in LLNL's Plutonium Facility (B332)

- The B332 stand-down and startup consisted of:
  - 12 representative operations that had to go through a formal resumption process
    - » Detailed formal documentation packages
    - » Re-training and certification of operators
    - » Revising/simplifying ALL criticality controls
    - » Re-locating Criticality Safety Staff into facility
    - » Formal verification and validation
    - » Re-alignment of responsibilities
    - » 21 month time delay
      - ♦ (facility shutdown July 15, 1997 - April 1, 1999)

HOOPER 11

Self Improvement Workshop



## Changes DOE-OAK has Made

- Reorganization of nuclear safety oversight
  - New nuclear safety team
  - Addition of two nuclear safety technical advisors
- Increased operational awareness of fissile material ops in B332
  - Assigned Facility Representative and Criticality Safety Engineer
  - Nuclear Safety Technical Advisors

HOOPER 12

Self Improvement Workshop



## Changes DOE-OAK has Made (Continued)

- Implementation of OAK Facility Ops Teams
  - Mix of programmatic, safety and security personnel
  - Work to ensure ES&H and Security issues are addressed “up-front” in planning of programmatic operations



HOOPER 13

Self Improvement Workshop

## Summary – Management Must

- Ensure people up and down the chain understand their responsibilities and are well trained
- Understand HOW Criticality Safety is being implemented in your facilities
- Have adequate oversight mechanisms in place
- Have formalized conduct of operations in place



HOOPER 14

Self Improvement Workshop















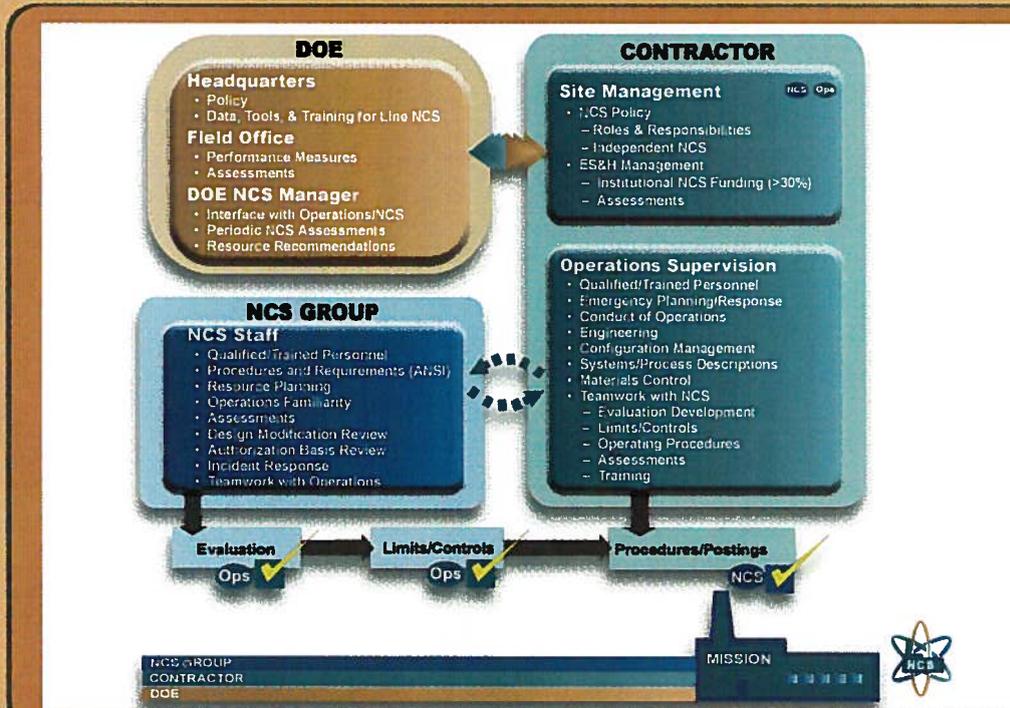
# What's Wrong with Criticality Safety Programs?



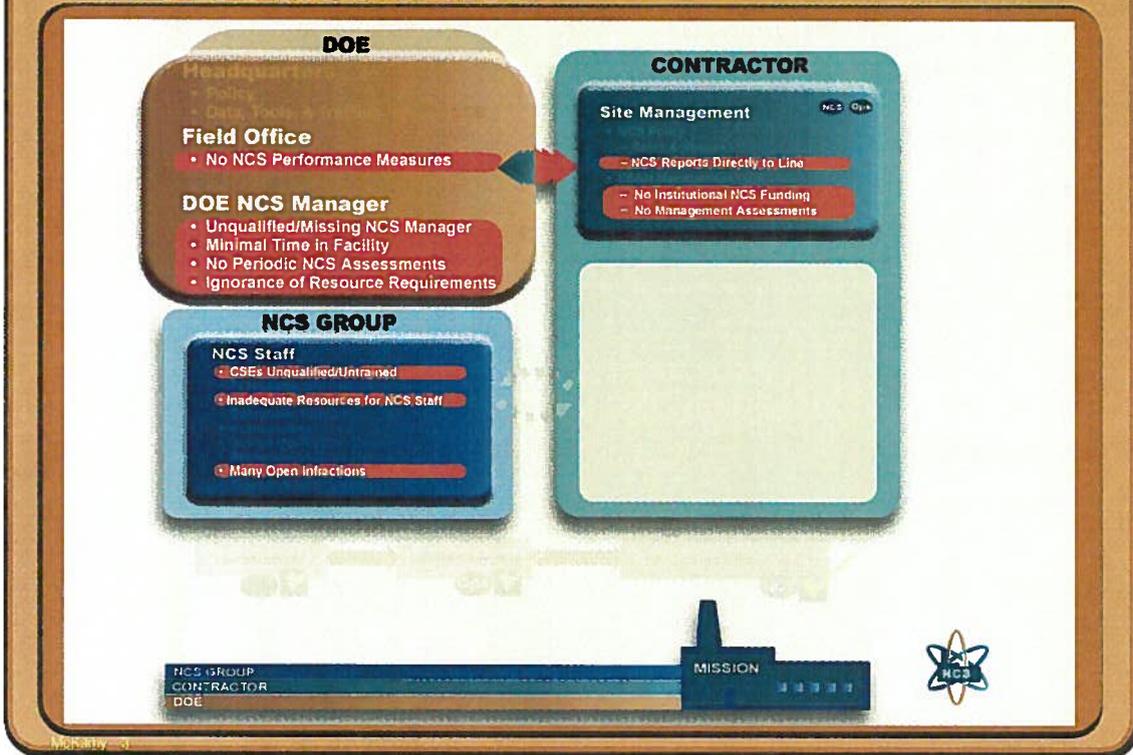
Dr. Jerry McKamy

DOE-EH

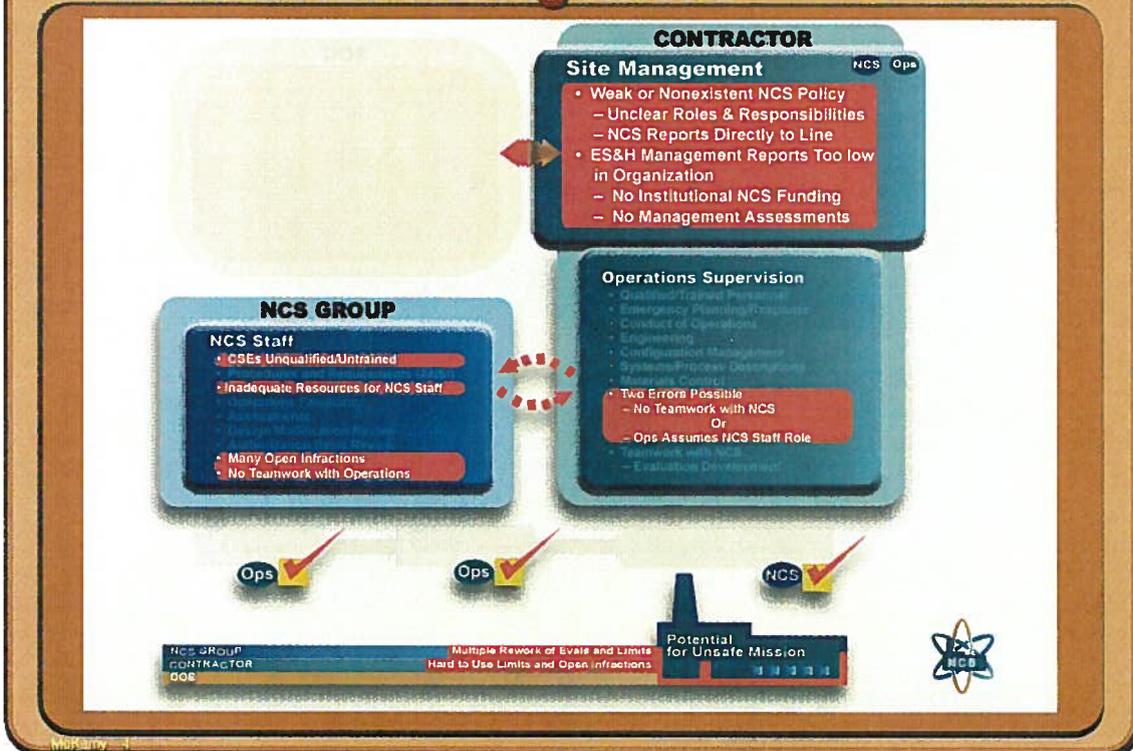
## Key Elements of a Healthy NCS Program



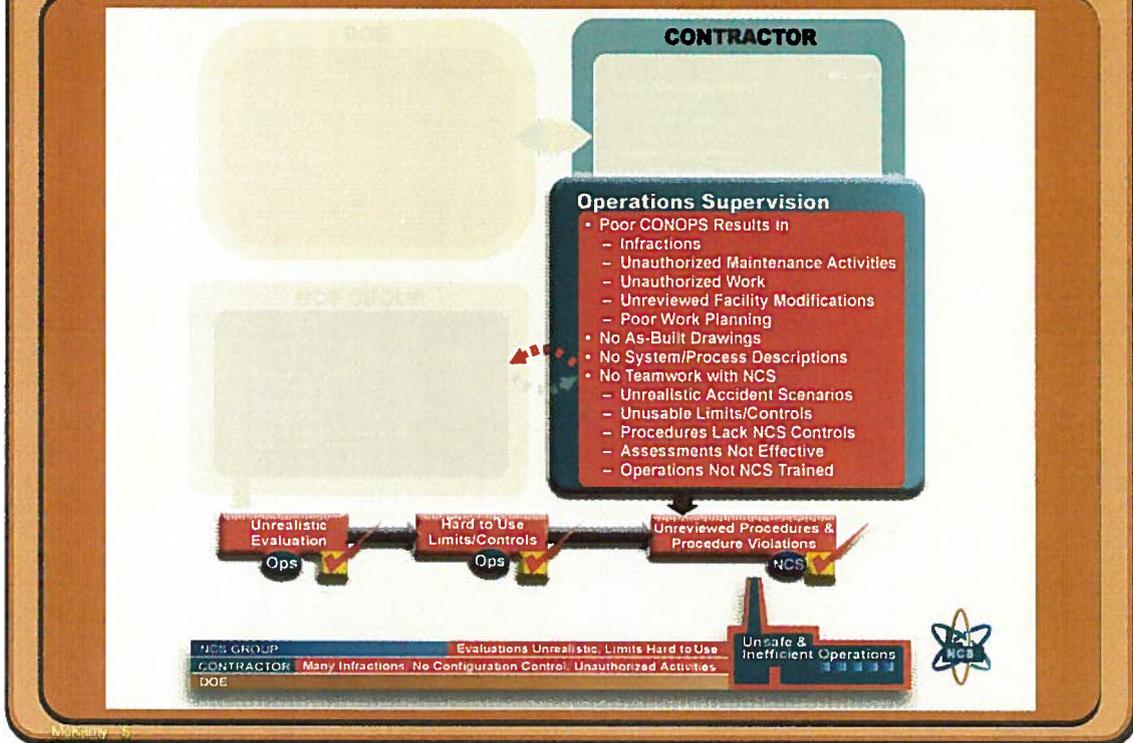
# Impacts of Typical Weaknesses in DOE Field Office



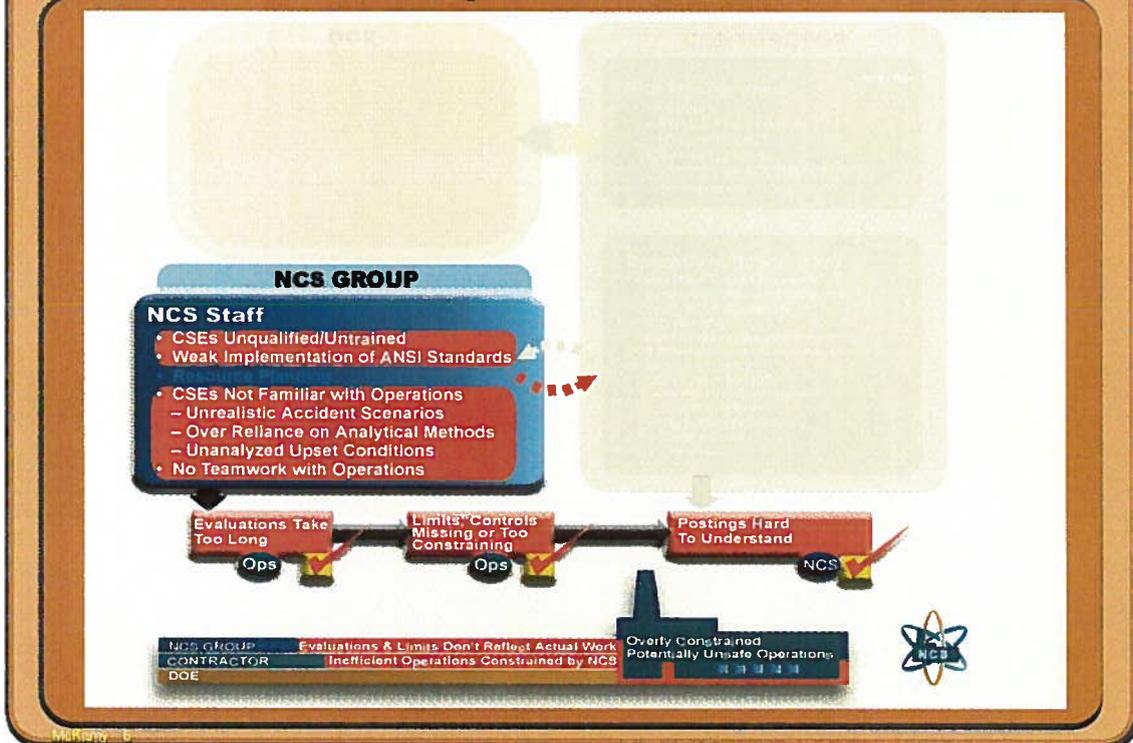
# Impacts of Typical Weaknesses in Contractor Management



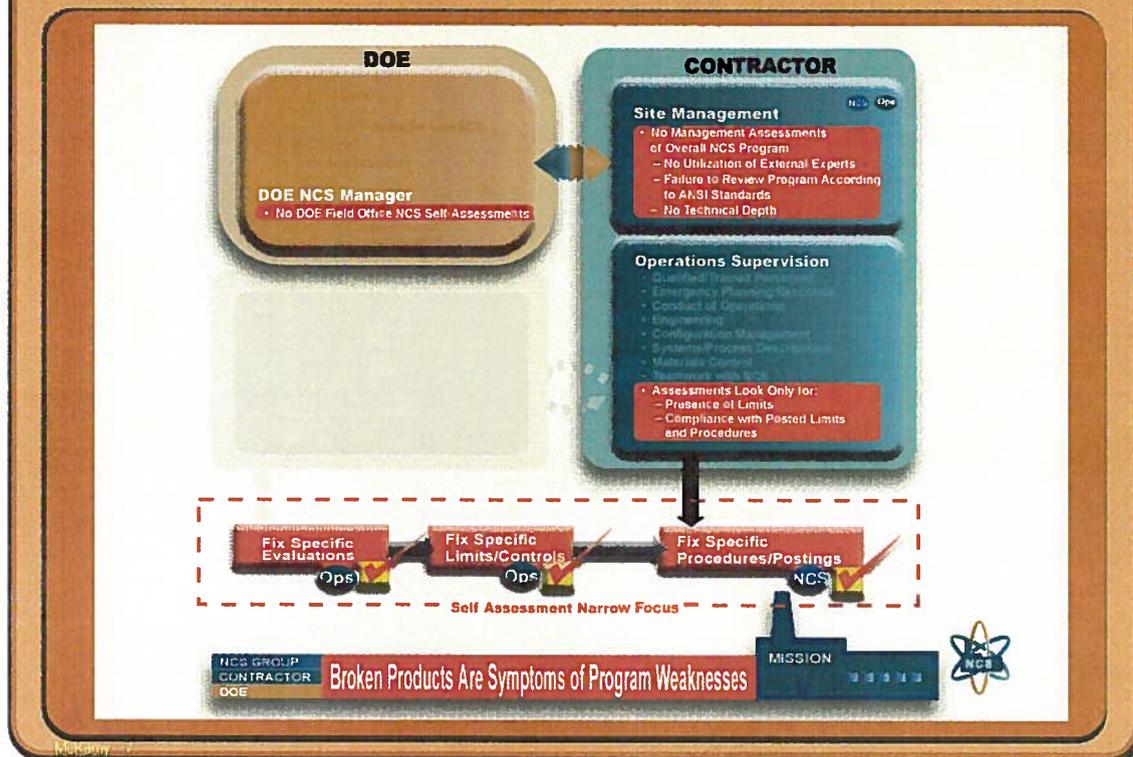
# Impacts of Typical Weaknesses in Operations Supervision



# Impacts of Typical Weaknesses in the NCS Group



# Typical Weaknesses in Self-Assessments















# An Operations View of Criticality Safety



R. D. Raaz

Production Integration  
Safe Sites of Colorado

RAAZ 1

## SSOC MISSION

Support RFETS site closure by removal of  
plutonium bearing materials

RAAZ 2



Self Improvement Workshop

## RFETS has Lots of Plutonium

- Metals and oxides
- Residues of every form
- Holdup by the kg
- Low level liquids
- High level liquids
- Weapons components

HAAZ 3



Self Improvement Workshop

## Criticality Safety Program Must Be

- Comprehensive - everyone involved
- Flexible - dozens of processes
- Simple - hundreds of operators

RAAZ 4



Self Improvement Workshop

## Sound Criticality Safety Program Obstacles

- Hundreds of existing legacy infractions
- Cumbersome limits
- Limit conflicts
- Poor communications between operations and criticality
- Technically weak Criticality Accident Alarm System (CAAS)

HAAZ 5



Self Improvement Workshop

## Sound Criticality Safety Program Obstacles (Continued)

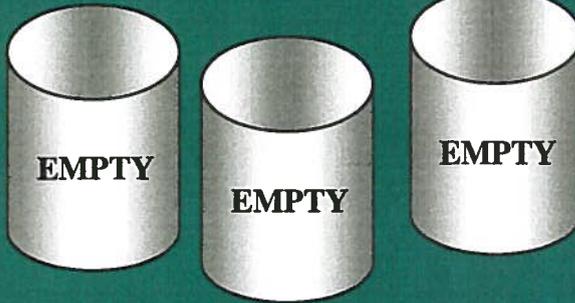
- Poor operator knowledge of limit basis
- Dramatic mission changes
- Multiple contractors
- But the biggest was perception . . . . .

HAAZ 6



Self Improvement Workshop

Now, How Can I Keep These Empty Drums From Going Critical?



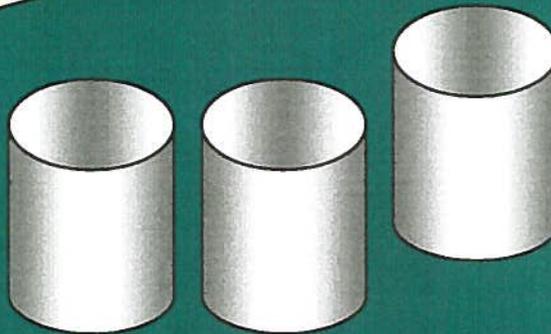
**Operations View of Criticality Engineering**



RAAZ 7

Self Improvement Workshop

Now, How In The World Can I Get This Mess To Go Critical?



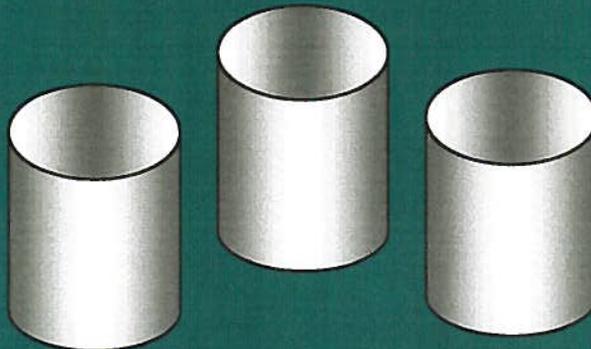
**Criticality Engineering View of Operations**



RAAZ 8

Self Improvement Workshop

Now, How Do We Do  
This Task Safely



**Teamwork!!**

RAAZ 9

Self Improvement Workshop



## Problem

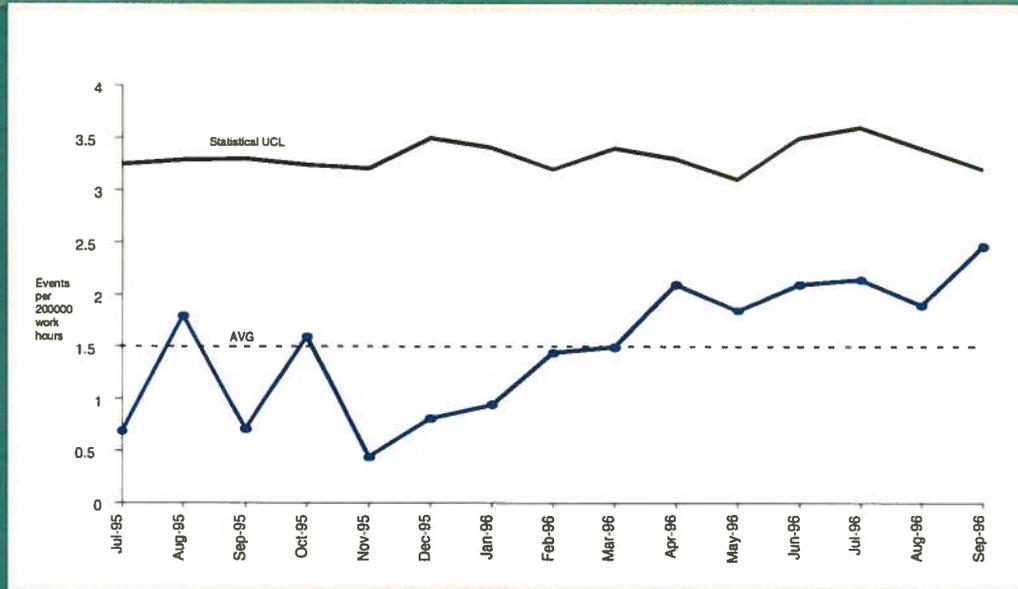
By late 1996, as operations heated up,  
the program was recognized to be headed  
for trouble. . . . .

RAAZ 10

Self Improvement Workshop



## Rocky Flats Site Nuclear Criticality Occurrences



HAAZ 11



Self Improvement Workshop

## RFETS 1996 Initiatives

- Overhaul criticality limit system
- Implement new criticality safety manual
- Assign criticality safety officers
- Conduct building criticality safety sweeps

HAAZ 12



Self Improvement Workshop

## Criticality Safety Officers

- The bridge between the program and operators
- Follow the details
- Can't be "The Program" - belongs to Facility Managers
- Have been the biggest contribution to changing our performance

HAAZ 13



Self Improvement Workshop

## But We Were Too Late: Thanksgiving Weekend 1996

- Widespread failures
- 12 drums moved from infracted room
- Shift manager thought scoping tour was what he authorized
- Multiple barriers busted
- Operators and managers failed

HAAZ 14



Self Improvement Workshop

## Effects

- “Turned the lights on”
- “Required work force survey”
- Energized line management
- Comprehensive cause analysis with corrective action plan

HAAZ 15



Self Improvement Workshop

## 1997 Actions

- Cleared all legacy infractions
- Examined every pre-1991 evaluation
- Changed every pre-1991 limit posting
- Completed 317 new mission evaluations
- Re-analyzed Criticality Accident Alarm System detector coverage in every nuclear facility

HAAZ 16



Self Improvement Workshop

## 1997 Actions (Continued)

- Conducted Criticality Accident Alarm System audibility testing in every nuclear facility
- Established site criticality safety council
- Completed 55-gallon drum evaluation
- Completed liquid “bottle study”
- Many, many more .....

RAAZ 17



Self Improvement Workshop

## 1998 Actions

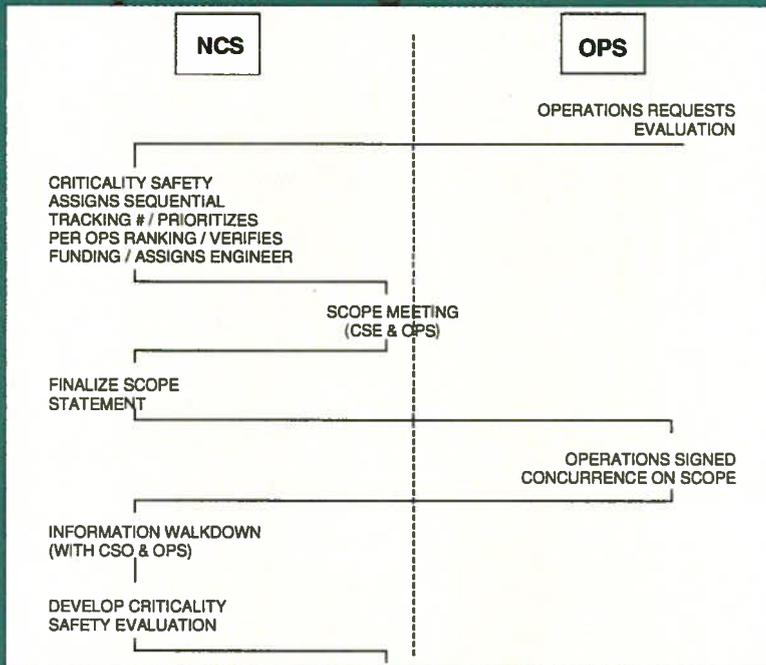
- Began implementation of “generic limits”
- Assigned Criticality Safety Engineers to building projects
- Digested the “Assay Uncertainty Pill”
- Reviewed/revised every evaluation done since 1991
- Strengthened operations participation in evaluation process

RAAZ 18



Self Improvement Workshop

# Criticality Evaluation Development Diagram

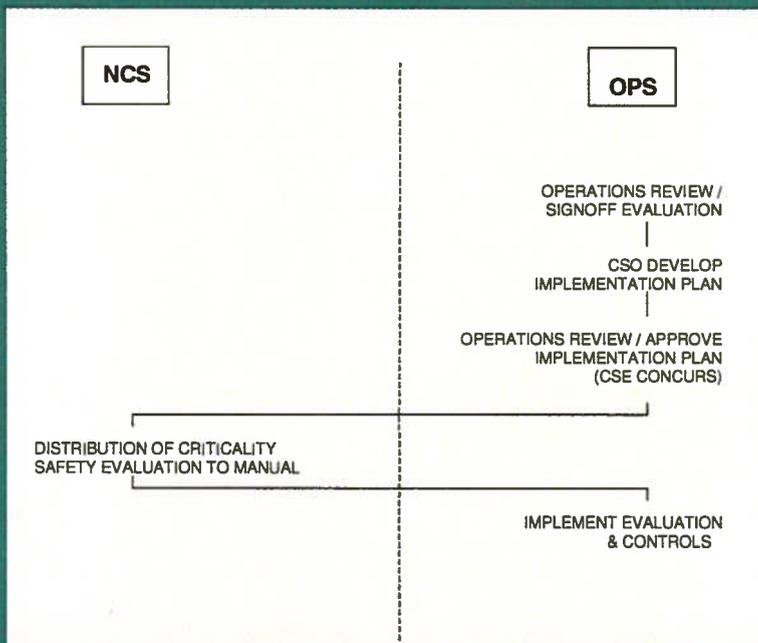


RAAZ 19

Self Improvement Workshop



# Criticality Evaluation Development Diagram (Continued)



RAAZ 20

Self Improvement Workshop



## Results

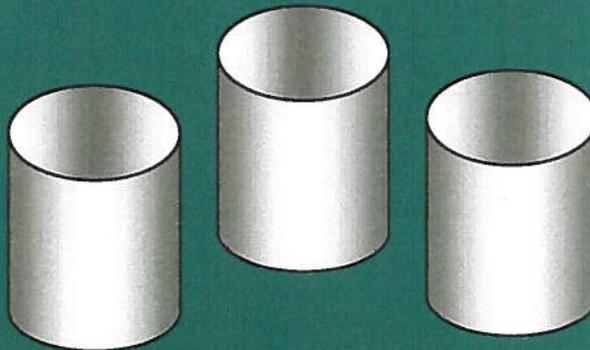
- Reduced occurrence rate
- Successfully brought five new processes on line
- Stabilized professional staff
- Significantly improved teamwork

RAAZ 21



Self Improvement Workshop

Now, How Do We Do  
This Task Safely



**Teamwork!!**

RAAZ 22



Self Improvement Workshop

## Stepping Back

- Criticality safety
- Nuclear safety
- Radiological safety
- Industrial safety
- Were all suffering to varying degrees, the same symptoms

RAAZ 23



Self Improvement Workshop

## Symptoms

- Sporadic performance
- Occasional dramatic failures
- Flagging customer confidence

RAAZ 24



Self Improvement Workshop

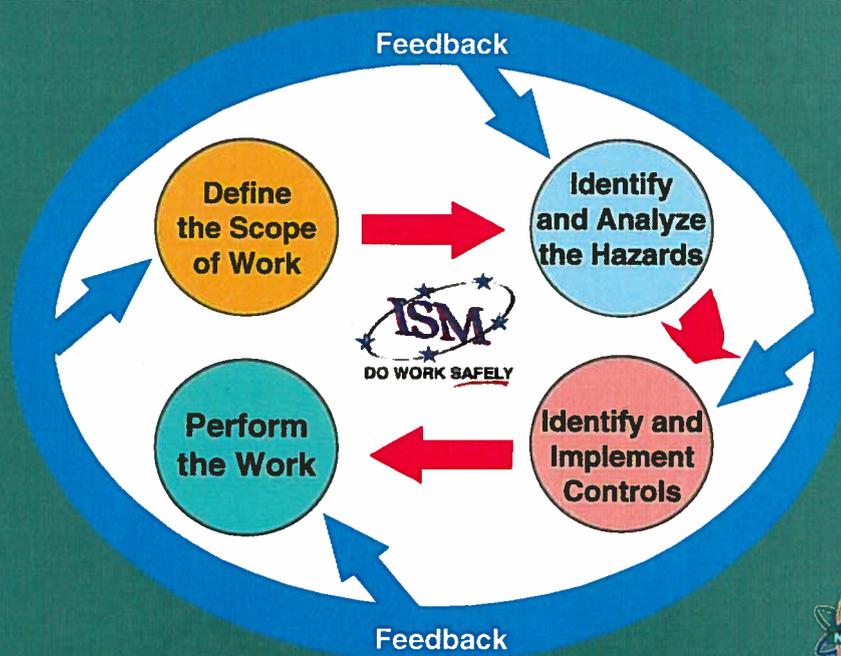
The Solution is Simple To State:

## INTEGRATED SAFETY MANAGEMENT

RAAZ 25



Self Improvement Workshop



RAAZ 26



Self Improvement Workshop

## Key Principles

- The line owns safety
- Operators must participate in identifying hazards
- Operators must understand the controls used to mitigate these hazards

HAAZ 27



Self Improvement Workshop

## Examples from Criticality Safety

- Operations describes the processing goals
  - Residue salts
- Operations holds up if necessary
  - Mass uncertainty
- Operations recognize invalid evaluation - Caustic Waste Treatment System
- Operations must recognize controls are no better than their implementation - B707

HAAZ 28



Self Improvement Workshop

## Summary

- Criticality safety program can be no better than the weakest of:
  - Technical support staff
  - Line management's ownership
  - Operator's understanding of the program

HAAZ 29



Self Improvement Workshop

## RFETS is Still Working Improvements

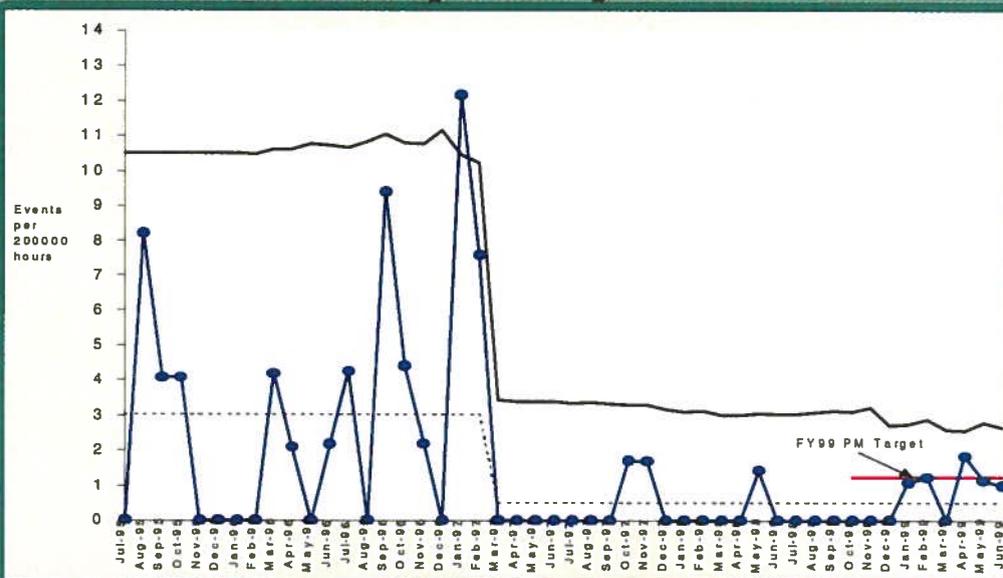
- Performance flat since 1997
- Infraction "peaks" September 1998, April-May 1999
- Integrated team with hourly workers established
  - Offsite bench marking
  - Postings still too complex
  - Limit traps due to legacy uncertainty
  - Personnel errors driving peaks

HAAZ 30



Self Improvement Workshop

## Safe Sites of Colorado Nuclear Criticality Safety Occurrences



RAAZ 31



Self Improvement Workshop

## Additional Ongoing Actions

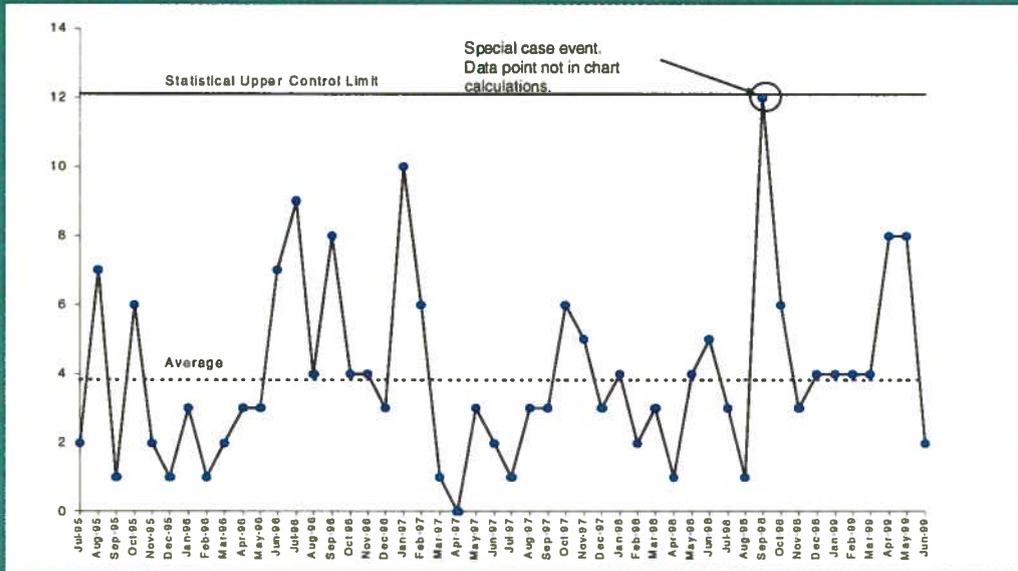
- Upgrade training CSEs and operators
- Targeted revisions to more complex evaluations
- Rebase limits to generic material classes
- Revise infraction procedure
- Enforced accountability

RAAZ 32



Self Improvement Workshop

# Safe Sites of Colorado Criticality Infractions



HAAZ 33



Self Improvement Workshop



# NOTES

Ideas for Improvement / Action Mentioned by Dick :

1) Need to retain & stabilize crit expertise pool to keep them from moving from site to site or out of the field

2) Understanding of NDA and its significance for NCS

3) Need to get feedback on best practices and experience at other sites.

The CSCT can play a major role in this. (Pet<sup>R</sup>)











# DOE's Integrated, Cross-Cutting Criticality Safety Program



Roger Dintaman  
DOE - DP

DINTAMAN 1

## DOE Nuclear Criticality Safety Program

- Scope and benefits
- Program accomplishments
- Technical assistance for line Criticality Safety programs

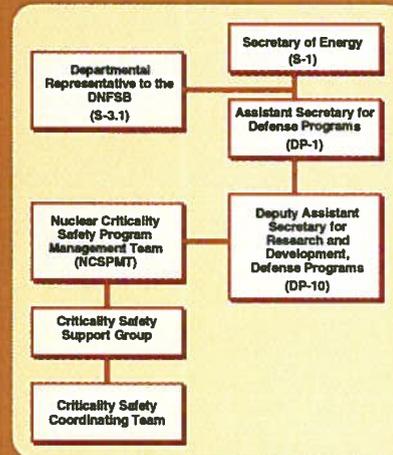
DINTAMAN 2



Self Improvement Workshop

## DOE Nuclear Criticality Safety Program

- Developed in response to DNFSB Recommendation 97-2
- Maintains essential infrastructure for line Criticality Safety programs
- Responsive to field needs



DINTAMAN 3

Self Improvement Workshop



## Our Goals

- Improve communication between Criticality Safety Practitioners and the Nuclear Criticality Safety Program
- Plan and prioritize allocation of limited resources
- Use five-year planning process with clear task objectives, milestones, & deliverables
- Schedule site visits and use Criticality Safety Experts to assist site managers

DINTAMAN 4

Self Improvement Workshop



## Seven Program Tasks

- The nuclear Criticality Safety Program consists of 7 Program Tasks
- Tasks are interdependent

DINTAMAN 5



## Seven Program Tasks - Task 1

- Critical Experiments
  - Provide experimental data to validate Criticality Safety analyses
  - Experiments are being planned and conducted at Los Alamos to provide validation data for several important DOE Programs

DINTAMAN 6



## Seven Program Tasks - Task 2

- Benchmarking
  - Identify, evaluate and disseminate benchmarked experiment data to validate Criticality Safety analyses at DOE sites
  - Major international effort led by the U.S. to acquire benchmark data to fill important gaps in our data base

DINTAMAN 7



Self Improvement Workshop

## Seven Program Tasks - Tasks 3 & 4

- Analytical Methods
  - Support and enhance numerical processing codes
  - Complex neutronics codes (KENO, MCNP, VIM) used by Criticality Safety Practitioners to perform Criticality Safety Evaluations
- Nuclear Data
  - Acquire and process nuclear data required for analytical codes
  - Nuclear data is being acquired and processed at Oak Ridge to support calculations for Criticality Safety Evaluations for priority DOE missions

DINTAMAN 8



Self Improvement Workshop

## Seven Program Tasks - Task 5

- Applicable Ranges of Bounding Curves and Data
  - Develop method(s) to interpolate and extrapolate from existing data
  - New activity began this FY with first outputs expected this fall
  - Validation of calculations in areas where benchmark data is unavailable

DINTAMAN 9



Self Improvement Workshop

## Seven Program Tasks - Task 6

- Information Preservation and Dissemination
  - Collect, preserve and make readily available Criticality Safety information
  - Data and other information important to Criticality Safety are being placed on a web site with links to other useful sites

DINTAMAN 10



Self Improvement Workshop

## Seven Program Tasks - Task 7

- Training and Qualification
  - Maintain and improve training of Criticality Safety Practitioners
  - Provide hands-on training at Los Alamos - new training course available in FY 2000
  - Develop new training materials
  - Develop qualification standards for federal and contractor employees

DINTAMAN 11



Self Improvement Workshop

## Funding Target

- 5-Year planning process updated annually
- DP, EM, & EH committed funding:
  - Funding targets for FY 2000 & beyond
  - DP                   \$6,250,000
  - EM                   \$3,750,000
  - EH                   \$ 220,000
  - Total               \$10,220,000

DINTAMAN 12



Self Improvement Workshop

## How Can We Help Each Other

- Your support is essential to make this successful
- Criticality Safety Coordinating Team (CSCT) provides conduit to access infrastructure support
- Criticality Safety Support Group (CSSG) is available to provide technical assistance



DINTAMAN 13

Self Improvement Workshop















# What the DOE Field Office NCS Program Should Look Like



Adolf Garcia  
DOE - ID

GARCIA 1

## Field Office NCS Program

- DOE P 450.5 "Line ES&H Oversight"
  - DOE Line and Contractor Self Assessment Program work together to ensure adequate NCS program
  - Policy and procedures
  - Performance measures
  - Line evaluations
  - Staff requirements
    - » Field Office Criticality "Champion"
  - Appraisals



GARCIA 2

Self Improvement Workshop

## Policy & Procedures

- Confirm contractor policies & procedures in accordance with DOE orders
  - Approved by senior management
  - Rational, implementable program
  - Operations buy-in
  - Includes self-assessment process

GARCIA 3



Self Improvement Workshop

## DOE Order

U.S. Department of Energy  
Washington, D.C.

**ORDER**  
DOE O 420.1

SUBJECT: FACILITY SAFETY

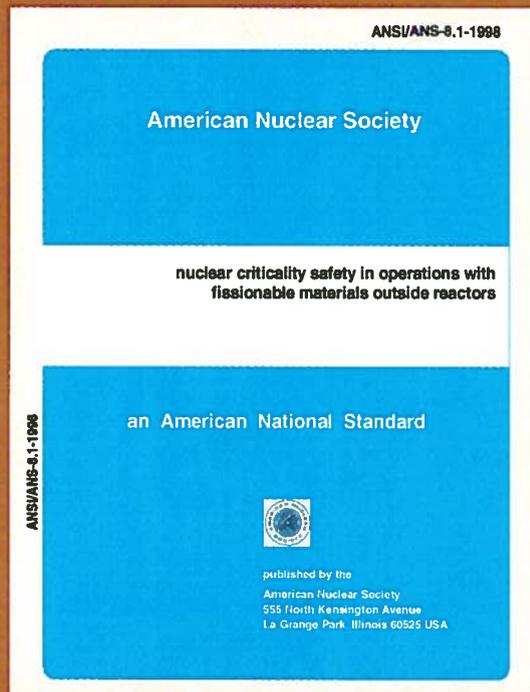
### 4.3. Nuclear Criticality Safety

GARCIA 4



Self Improvement Workshop

## NCS ANSI Standard



GARCIA 5

Self Improvement Workshop



## Performance Measures

- Work with contractor to establish performance expectations
  - Timely infraction closure
  - Avoiding repeat infractions
  - Time spent by the Criticality Safety Engineer on the floor
  - Reducing discrepancies between evaluations, postings, and procedures
  - Minimize infractions discovered by oversight
  - Formal training
  - Criticality Staff attendance at professional technical conferences
  - Self assessment performed by contractor

GARCIA 6

Self Improvement Workshop



## Line Evaluations

- Monitor implementation of Criticality Safety Program
  - Frequency and depth to verify performance
  - Selected review(s) of Criticality Safety Evaluations, postings, and procedures
  - Maintain knowledge of resource requirements to support program and budget decisions

GARCIA 7



Self Improvement Workshop

## Staff Requirements

- Maintain Criticality Subject Matter Expert on staff
  - Qualified per DOE NCS Qualification Standard
    - » Knowledge of Criticality Physics, regulations, guides and Criticality Safety practices
    - » Robust training program
  - Use of DOE/HQ and consultants

GARCIA 8



Self Improvement Workshop

## Appraisals

- Perform periodic appraisals
  - Formal, structured appraisals
  - Frequency and duration to confirm effectiveness of contractor's program
  - Scope based on analysis of contractor self-assessments, performance measures and operational awareness
  - Close coordination with facility representatives and ES&H personnel

GARCIA 9



Self Improvement Workshop

## Summary

- Place a high value on DOE and contractor teamwork to get results
- Criticality oversight must be structured and professionally performed
- Qualified subject matter experts are required

GARCIA 10



Self Improvement Workshop

## Summary (Continued)

- Adapt Field Office Program based on contractor effectiveness
  - As contractor programs evolve, DOE oversight transitions to:
    - » Operational awareness of activity, using SMEs and Facility Representatives
    - » Review against formal performance measures
    - » Support of ORRs and ISMS
    - » Periodic value-added appraisal















# What Should the Contractors NCS Program Look Like?



Jim Mincey

Presented by: Calvin Hopper  
ORNL

MINCEY 1

## Elements of an Effective NCS Program

- Clearly defined NCS responsibility
- Tailored NCS analyses
- Tailored NCS limits and controls
- Maintenance of NCS limits and controls
- Sustainable continuous improvement

MINCEY 2



Self Improvement Workshop

## Clearly Defined NCS Responsibilities

- ANSI/ANS-8.19-1996, “Administrative Practices for Nuclear Criticality Safety”



- Management NCS program responsibilities
- Line supervision NCS program responsibilities
- NCS staff responsibilities
- Consensus on: operating procedures, material control, NCS analyses, and accident response

MINCEY 3



Self Improvement Workshop

## Clearly Defined NCS Responsibilities (Continued)

- Management NCS responsibilities
  - Obvious continuous interest in NCS
    - » Develops written NCS policies/responsibilities
    - » Goals for sustainable NCS improvement
    - » Determines how the NCS staff is selected and funded
  - Funding for both operations and infrastructure
  - Periodic assessments of NCS program
  - Makes NCS part of a corporate culture where safety is a personal responsibility

MINCEY 4



Self Improvement Workshop

## Clearly Defined NCS Responsibilities (Continued)

- Line supervision NCS responsibilities
  - Knowledgeable and responsible for NCS
  - On-the-job NCS operations training
  - Ensuring procedures reviewed and current
  - Ensuring NCS requirements are satisfied
  - Ensuring fissionable material is labeled
  - Ensuring the safety culture supports NCS

MINCEY 5



Self Improvement Workshop

## Clearly Defined NCS Responsibilities (Continued)

- NCS staff responsibilities
  - Design & review of hardware & procedures
  - Assisting with NCS training (as requested)
  - Familiarity with supported operations
  - Conducting audits
  - Proficiency with methods & requirements
  - Resource for bringing in outside expertise
- Direct Funding only Works for First Two!

MINCEY 6



Self Improvement Workshop

## Clearly Defined NCS Responsibilities (Continued)

- Other safety program interfaces (beyond ANS-8.19) also exist!
  - Configuration control of hardware
  - Configuration control of procedures
  - Facility Authorization Basis control
  - Coordination with quality assurance
  - Coordination with radiation protection
  - Coordination with compliance training

MINCEY 7



Self Improvement Workshop

## Tailored NCS Analyses

- Ensure methods used to detect accumulations are adequate
- Develop standard NCS control methods for routine problems
  - Standard container and operations limits
  - Criteria for exemption from analyses
- For unique problems, tailor NCS analyses; Don't Overkill!



Analysis: not  
brute force!

MINCEY 8



Self Improvement Workshop

## Tailored NCS Analyses (Continued)

- Develop credible accident scenarios
  - Joint activity: line supervision, operators, maintenance, support engineering, and NCS staff
- Identify preferred control methods
  - Line supervision, operators, maintenance, and support engineering recommend the methods
  - NCS staff evaluates feasibility and reliability
- NCS staff performs analyses as a service; analyses are not injunctions!

MINCEY 9



Self Improvement Workshop

## Tailored NCS Limits and Controls

- NCS analyses recommend NCS limits and controls to satisfy
  - Contractual NCS requirements
  - ANSI/ANS-8 standards
- Line supervision must
  - Sanction NCS analysis recommendations
  - Accept ownership of NCS limits and controls
- Management makes the process work

MINCEY 10



Self Improvement Workshop

## Tailored NCS Limits and Controls (Continued)

- Approval Of NCS limits and controls
  - Joint activity: line supervision and NCS staff
  - Approval document “owned” by line supervision
- Incorporation of limits and controls
  - Line supervision, maintenance, and support engineering accordingly modify procedures and other documents; NCS staff reviews
  - Modification of facility authorization bases documentation; NCS staff reviews

MINCEY 11



Self Improvement Workshop

## Maintenance of NCS Limits and Controls

- Line supervision “owns” NCS limits and controls
  - Approves operations startup after verifying NCS requirements are satisfied
  - As-built hardware drawings, specifications for repairs, specifications for replacements
  - Operating, maintenance, and emergency procedures and on-the-job training
  - Postings and labeling fissionable material



Key to  
ownership!

MINCEY 12



Self Improvement Workshop

## Maintenance of NCS Limits and Controls (Continued)

- NCS limits and controls should frequently be validated by Line supervision
  - Procedurally implemented limits/training
  - Active-engineered device maintenance
  - Wear & tear to passive-engineered features
- Line supervision should authorize changes to NCS limits and controls

MINCEY 13



Self Improvement Workshop

## Maintenance of NCS Limits and Controls (Continued)

- NCS staff assists Line managers by
  - Being readily available for consultation on understanding/improving limits and controls as well as reviewing proposed changes
  - Being on-call 24 hours for emergencies
  - Periodically verifying that NCS analyses and underlying assumptions have remained consistent with operations
  - Advocating usable Facility Authorization Bases NCS documentation

MINCEY 14



Self Improvement Workshop

## Maintenance of NCS Limits and Controls (Continued)

- NCS staff should be sized/assigned to minimize delays
  - NCS staff must be available to operations for timely procedure and hardware change support
  - Knowledgeable NCS staff must be available to provide support and guidance to operations; assigned points of contact are desirable
  - Line supervision should view the NCS staff as a vital technical support resource

MINCEY 15



Self Improvement Workshop

## Sustainable Continuous Improvement

- NCS staff, line supervision, and management must learn from failures
  - Develop predictive indicators, such as escalating procedural violations, to spot operations headed for NCS infractions
  - Track status of corrective actions, audits, processing of change requests, etc.
  - Resources must be balanced between problems and program



MINCEY 16



Self Improvement Workshop

## Sustainable Continuous Improvement (Continued)

- Communicate lessons-learned
  - Share NCS infractions and problems with management, line supervision, and NCS staff even if external reporting is not required
  - Ensure management, line supervision, and the NCS staff are cognizant of failure root causes
  - Develop an internal NCS reporting system if the external reporting system does not adequately provide a good summary of the site NCS posture

MINCEY 17



Self Improvement Workshop

## Sustainable Continuous Improvement (Continued)

- Follow-up lessons-learned
  - Incorporate lessons-learned into existing/future NCS limits and controls
  - Modify, as necessary, credible process upsets
  - Integrate them into on-the-job training
  - View NCS on-the-job training as a source for lessons-learned

MINCEY 18



Self Improvement Workshop

## Sustainable Continuous Improvement (Continued)

- Turn lessons-learned into sustainable continuous improvement
  - Contractor management should define attainable goals to reward improvement and avoiding repeat problems
  - Line supervision should treat safety the same as any other performance objective

MINCEY 19



Self Improvement Workshop

## Sustainable Continuous Improvement (Continued)

- NCS staff should be a key resource to improving operations
  - Improve NCS staff understanding of operations
  - NCS staff must keep analytical skills current
  - NCS staff should strive to reduce the time taken to process changes
  - NCS staff should be involved with development of regulations and contractual requirements

MINCEY 20



Self Improvement Workshop

## Summary

- NCS program must have Line supervision and management involvement
- Effective NCS seamlessly merges with ISMS program
- Set improvement goals/find resources
- Close working relationship with DOE field office improves effectiveness



A balanced approach



MINCEY 21

Self Improvement Workshop















# Y-12 Criticality Safety Program Path Forward

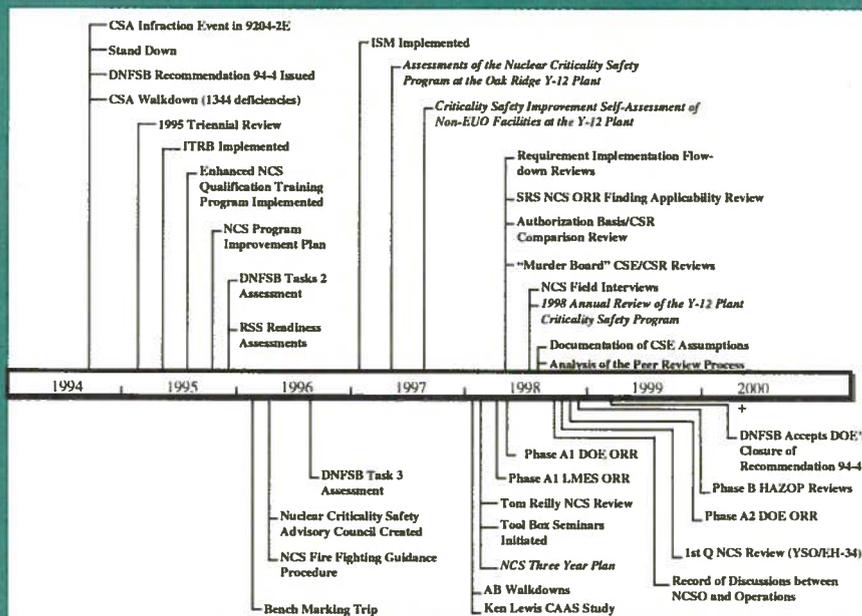


Margaret Morrow

Deputy Vice President for Defense Programs  
LMES – Y-12 Plant

MORROW

## Y-12 Nuclear Criticality Safety Timeline



MORROW

2



Self Improvement Workshop

## Management Actions

- Directed stand down of fissile material activities in September 1994
- Performed Criticality Safety Approval walkdown
  - 1344 deficiencies identified
- Performed Type-C root cause investigation of CSA infraction in 9204-2E
- Developed NCS Program Improvement Plan
- Implemented enhancements to the NCS Qualification Training Program

MOHROW 3



Self Improvement Workshop

## Management Actions (Continued)

- Created the Nuclear Criticality Safety Advisory Council
- Developed NCS 3-Year plan
- Implemented lead facility NCS engineer concept
- Developed CSR process for Enriched Uranium Operation (EUO)
- Implemented integrated safety management
  - NCS involvement on operational safety boards

MOHROW 4



Self Improvement Workshop

## Management Actions (Continued)

- Implemented enhanced peer review process
- Implemented Experienced Technical Review Group to facilitate transfer of senior NCS expertise
- Implemented hazards reviews as input information for EUO Phase B chemical process Criticality Safety Evaluations

MORROW 5



Self Improvement Workshop

## Overview of Resumption Activities

- Five restart efforts successfully completed to date
- Additional restarts in-progress
- Major assessments of the NCS program since 1994 include
  - 1995 Triennial Review
  - DNFSB Task 2 Assessment
  - DNFSB Task 3 Assessment
  - Facility Readiness Assessments
  - EUO Phase A1/A2 ORRs
  - 1998 Plant NCS Committee Annual Review
  - YSO/EH-34 Quarterly Review

MORROW 6



Self Improvement Workshop

## Improvements to NCS Program

- Since the stand down in 1994, Y-12 has instituted numerous improvements to the NCS program including:
  - Worker understanding of, and adherence to, NCS requirements
  - Technical quality of underlying NCS evaluations and process analyses
  - Effectiveness on the management and leadership of the NCS program
  - Self assessments

MORROW 7



Self Improvement Workshop

## Improvements to NCS Program (Continued)

- Enhancements to the NCS Qualification Training Program
- Empowerment of Shift Technical Advisors
- Criticality Safety requirements implemented in procedures
- Transfer of senior NCS expertise
- Development of new NCS personnel

MORROW 8



Self Improvement Workshop

## Improvements in Line Ownership

- Line ownership has actively embraced ownership of NCS program as indicated in implementation of
  - Technical Support Organization in Enriched Uranium Operations
  - Facility Lead NCS Engineer concept
  - First-use controls
  - Tool box seminars

MORROW 9



Self Improvement Workshop

## Collaboration with DOE

- Worked with YSO and DOE-HQ to:
  - Improve clarity and technical content of process analyses
  - Ensure proper closure of NCS-related issues
- Weekly meetings between NCSO management and YSO NCS personnel

MORROW 10



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## Path Forward

- Process analysis upgrade performance metric
- Out-of-specification container resolution project
- Continue to improve NCS/facility safety interface
- Future assessment activities EUO Phase B support
  - Improved input (process descriptions and hazards evaluations)
  - Continued evolution of Criticality Safety Evaluation (rigor of documentation)

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## Path Forward (Continued)

- Continue moving to a performance-based operation
- Leadership and teambuilding training
  - Higher level of teamwork
  - Greater ability to resolve technical conflict when using rigorous design basis
  - Stabilize work environment

MORROW 12



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## Summary

- Through self-assessments, Y-12 continues to proactively identify any issues or attitudes that contributed to past problems
- The more we take an introspective look, the healthier the overall NCS program eventually becomes

MORROW 13



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# Hanford Path Forward – In Progress



Duane Renberger

Senior Director  
FDH

RENBERGER 1

## Introduction

- Structure of Project Hanford Management Contract
- Fluor Daniel Hanford criticality program
- Successful resumption of operations at PFP

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## Project Hanford Management Contract (PHMC)

- Major subcontractors (MSCs)
  - Babcock & Wilcox Hanford Company (BWHC)
  - Lockheed Martin Hanford Corporation (LMHC)
  - Numatec Hanford Corporation (NHC)
  - Protection Technology Hanford (PTH)
  - Waste Management Federal Services of Hanford, Inc. (WMFSH)
  - DynCorp Tri-Cities Services, Inc. (DYN)

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## Project Hanford Management Contract PHMC (Continued)

- Enterprise companies
  - Fluor Daniel Northwest, Inc. (FDNW)
  - Lockheed Martin Services, Inc. (LMSI)
  - Waste Management Federal Services, Inc., Northwest Operations (WMNW)
  - COGEMA Engineering Corporation (COGEMA)

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## Project Hanford Management Contract PHMC (Continued)

- Major fissile materials facilities
  - 324/327 Buildings
  - Fuel Shutdown Supply (FSS)
  - Fast Flux Test Facility (FFTF)
  - 222-S Laboratories
  - Plutonium Finishing Plant (PFP)

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## Project Hanford Management Contract PHMC (Continued)

- Central Waste Complex (CWC)
- Waste Recovery and Processing Facility (WRAP)
- K-Basins (East and West)
- Tank Farms
- 340 Building

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## Fluor Daniel Hanford Criticality Program

- FDH uses procedures to communicate NCS requirements to MSCs
- Project directors are responsible for implementing NCS at PHMC facilities
- Each major fissile materials facility has a Criticality Safety Representative (CSR) who is the point-of-contact for criticality safety

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## Fluor Daniel Hanford Criticality Program (Continued)

- The CSR relies on an outsource vendor (FDNW) to supply Criticality Safety Specialists (CSSs)
  - Criticality Safety Evaluations (CSEs)
  - Review operating procedures
  - Criticality Prevention Specifications (CPSs)
  - Criticality Safety Postings (CSPs)
- In January 1999, FDH criticality safety resource increased from 1/2 FTE to 2 FTEs
- Subcontracted NCS resources utilized

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## Fluor Daniel Hanford Criticality Program (Continued)

- Current contractual structure fragments an integrated criticality safety program into small pieces without adequately considering the historical linkage between these pieces and without ensuring that bridges are in place to mitigate the impact
- M&I contract structure and the outsourcing of criticality engineers have made baseline funding of FDNW difficult
- MSCs prefer to fund task orders instead of baseline needs

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## PFP Path Forward

- Description of management actions
- Seven recommendations resulting from an FDH assessment:
  - Maintain and strengthen core group (FDNW) of criticality safety experts
  - Provide core group baseline funding
  - Require major subcontractors to use core group
  - Define clear roles and responsibilities
  - Strengthen oversight

RENBERGER 10



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## PFP Path Forward (Continued)

- Revise procedures to strengthen links between program areas and ensure contractual imposition on MSCs
- Strengthen role of FDH
- Improvements made to the program
  - Reviewed all the CSERs that were needed for PFP startup
  - Phased corrective actions from the 1998 FDH Review of the criticality safety program
  - Independent verification that the corrective actions were completed

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## PFP Path Forward (Continued)

- Trained CSSs to support PFP startup
- Revised CSER preparation procedure
- Clarified documentation of Double Contingency Principle in the CSERs.
- Involved Line management (operations and engineering) in CSERs input and review

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## FDH Path Forward

- Improvements in line ownership and participation in NCS
  - The CSR function has been strengthened by providing increasingly qualified CSSs
  - Involved Line management in CSER input and review
  - Lessons learned from PFP have been incorporated into the site-wide FDH program

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## FDH Path Forward (Continued)

- Collaboration with DOE to improve program
  - Close contact with DOE-EH-34 on providing training to improve the quality of the FDNW evaluations
  - Close collaboration with DOE-RL to develop FY 1999 Performance Expectation Plans (PEPs)
  - Supported DOE-RL with DNFSB 97-2 criticality survey
  - Hold regularly scheduled meetings

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## FDH Path Forward (Continued)

- Providing adequate funding for NCS infrastructure
  - FDH directed the MSCs in the PHMC to fund FDNW
  - Over \$2 million has been committed to FDNW for FY 1999
  - Similar budgeting effort is now under way for FY 2000

RENBERGER 15



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## FDH Path Forward (Continued)

- Proactive role of integrating contractor
  - Performed a management assessment and instituted a Corrective Action Plan to strengthen the entire PHMC Program
  - Self-imposed Independent Program Assessments (IPA)
  - Actively working with the Project Director in support of the PHMC Program

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## FDH Path Forward (Continued)

- Successful use of ANSI/ANS-8.19 criteria as a self-improvement tool
  - Used by FDH to develop corrective actions to the DOE-EH-34 findings and comments resulting from their March 1998 visit to PFP

RENBERGER 17



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## Summary

- For an NCS Program to be effective in providing directives and oversight:
  - The NCS Organization must clearly understand that its customer is the worker; that its goal is to help the Line management ensure worker safety
  - In order to accomplish this goal, the NCS Organization must have competent personnel; not only experienced with analysis, but also familiar with the facility and operations under its oversight

RENBERGER 18



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## Summary (Continued)

- The NCS Organization needs consultants to supplement the NCS Program, but the NCS Organization must not depend on outside vendors for the core of its work
- The NCS Organization must have a well-funded baseline budget
- It must be highly visible in the management structure, but it must not report to Operations

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## Summary (Continued)

- Nuclear criticality safety, like Radiation Protection, must be a continuous process of surveillance, training, and involvement in worker safety
- Finally, invest in safety from the start because in the NCS world there is no such thing as “Pay Now or Pay Later.” With NCS we have to pay now. There is no “Later”

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# Paths Forward - In Process



Dennis Fisher  
UC LLNL

Fisher 1

## Topics

- Background
- Issues and initiatives
- Results
- Lessons learned
- Future concerns

Fisher 2



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## Background Information

- In the early 1990s, the LLNL Criticality Safety group was dissolved and staff were assigned to Safety Teams; they remained connected through a technical discipline leader
- In 1996, a DOE audit identified several concerns regarding the Criticality Safety function results
- In late 1996, the Criticality Safety group was reformed
- In July 1997, our Pu facility experienced the first of several incidents relating to Criticality Safety. The facility went into standby mode in July 1997
- For the next 21 months, the Pu facility carried out a carefully structured resumption of activities
- In April 1999, LLNL's Pu facility resumed full operation

Fisher 3



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## The Issue was Deeper than Simply CS

- On the surface: Criticality Safety issues
  - Inadequate Criticality Safety resource
  - Inadequate management attention
  - Complicated Criticality Safety controls
- More deeply: ISM-related issues
  - Conduct of operations
  - Unclear roles and responsibilities
  - Lack of clear work control process
  - Lack of effective feedback improvement
  - Inadequate training

Fisher 4



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## The LLNL Criticality Safety Program Was Enhanced Along With Implementing ISM

- Institutional initiatives
  - Audit concerns resulted in reforming the Criticality Safety group in 1996
  - Strong management support resulted
    - » Increase of Criticality Safety Engineers from 3 to 9 FTEs
    - » Fenced support for Criticality Safety as a discipline
    - » Closer oversight by the Deputy Director for Operations
- Pu Facility initiatives
  - Formalized work control process as part of implementing ISM
  - Co-located Criticality Safety Engineers into the facility to provide closer support
- Program initiatives
  - Appointed Nuclear Material Technology Program Leader to be responsible both for facility and programs
  - Clarified line management's roles and responsibilities in safety



Fisher 5

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## The Criticality Safety Group Initiated Several Operational Support Changes

- Provided customer-oriented Criticality Safety services
  - Met regularly with fissile material handlers to receive feedback
  - Met with responsible individuals to find out what is coming
- Assigned Criticality Safety engineers to support particular facility/rooms
  - Walked the floor and resolved Criticality Safety questions
  - Assured accountability
- Performed formal walkthroughs with room responsible individuals
- Attended facility daily briefing to know the activities



Fisher 6

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## Results Indicate that the Initiatives are Working

- Facility/programs consider Criticality Safety Engineers as part of their teams
- Communications have been enhanced by walking the floor
- Criticality Safety staff more proactive rather than reactive
  - Receive feedback regularly through informal meetings and contacts
  - Streamline Criticality Safety controls as the result of the feedback
- Continued management involvement to address any issues
- Recent resumption audit by DOE/OAK indicated the Criticality Safety program in B332 is satisfactory



Fisher 7

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## What are the Lessons Learned?

- Criticality Safety must be maintained as a distinct discipline
- Many of the Criticality Safety issues were conduct of operations related problems
- Good communications and management of interfaces are essential
- Criticality Safety support must be closely coupled with programmatic activities
- Senior management needs to be involved to provide resources and oversight

**Criticality Safety is a “critical skill” for DOE**



Fisher 8

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## There are Several Potential Future Concerns

- The Criticality Safety work force is aging and there are very limited numbers of Criticality Safety Engineers nationally
  - We must encourage careers in this field
- Support for the core competency areas is essential
  - Staff training and qualification, particularly in facility-specific knowledge and communication skills
  - Professional growth and development of Criticality Safety Engineers
- Reasonable career growth paths for Criticality Safety Engineers are needed



Fisher 9

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# A Model for Self-Improvement

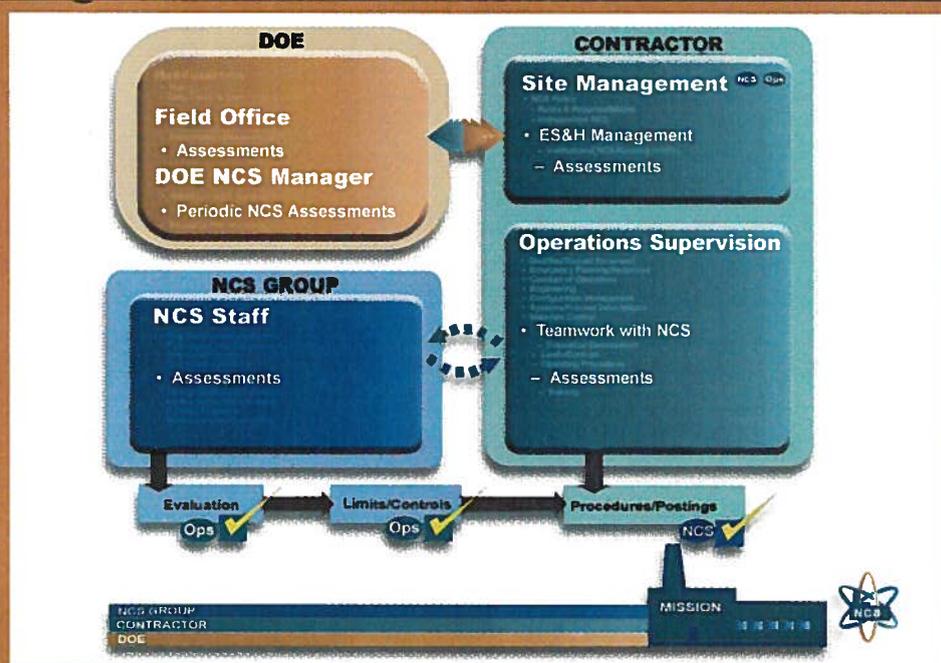


Dr. Jerry McKamy

DOE-EH

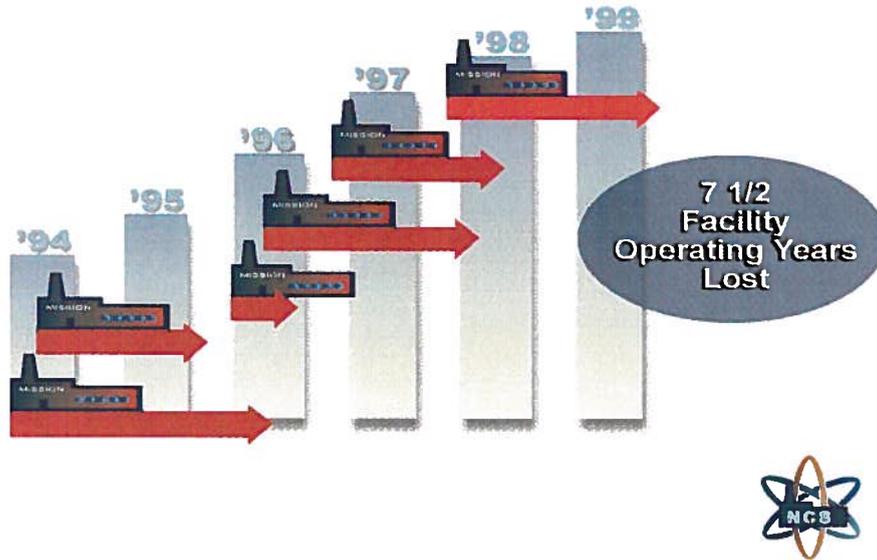
McKamy 1

## Role of Assessments in a Healthy NCS Program



McKamy 2

## NCS Related Stand Downs 1994–1999



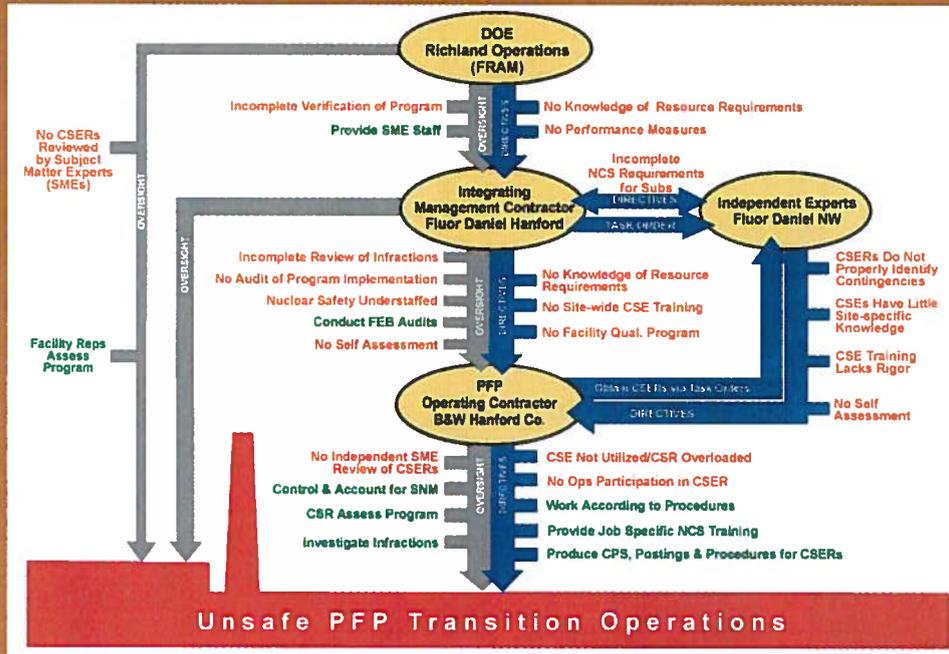
McKamy 3

## Case Study of Hanford – PFP Self Assessment

- 1997
- December 24, 1996** – BWHC curtails fissile materials operations at PFP due to numerous Criticality Safety Infractions
  - November 1997** – Both BWHC and FDH declare readiness to resume Phase 1 Operations at PFP after performing formal Readiness Assessments
  - November 20, 1997** – Another Criticality Safety infraction occurs at PFP and DOE RL postpones Restart until they can arrange external review
  - December 1997** – Outside NCS expert recommends additional short term corrective actions and a comprehensive program review
- 1998
- March 1998** – RL conducts comprehensive NCS program review utilizing ANSI/ANS-8.19 criteria and external expertise
    - Discovered a CSE that permitted unsafe operations
    - Essentially complete failure of the NCS program elements
  - Summer 1998** – BWHC and FDH implement recommendations from March 1998 review at PFP
- 1999
- December 1998** – DOE ORR for PFP produces ZERO NCS findings

McKamy 4

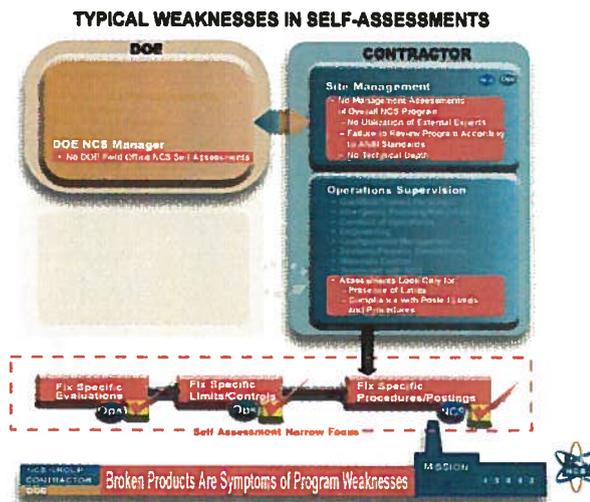
# NCS Program Assessment Findings



McKamy 5

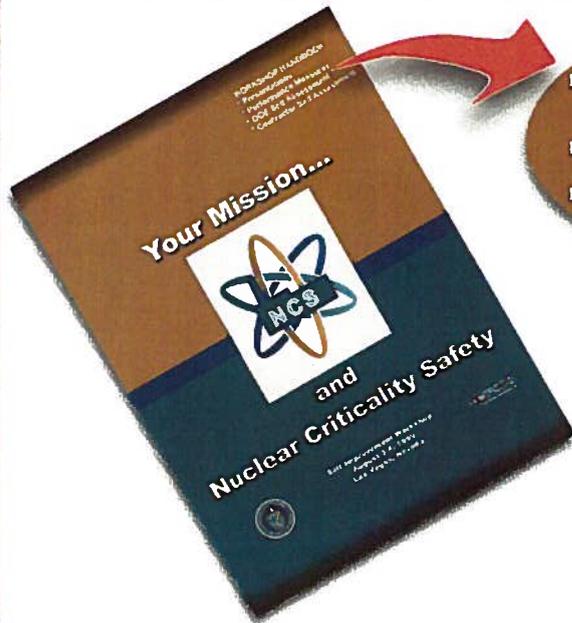
# How Did the Readiness Assessments Fail to Discover the Problem?

- Focused on paper "End Products" (limits & procedures) Only
- Did Not Examine "Big-Picture" Program Infrastructure and Relationships
- Did Not Utilize ANSI/ANS-8.19 Criteria to Examine Integrated Program
- Did Not Look for Root Causes
- Limited Expertise and Reluctance to Utilize External Subject Matter Experts



McKamy 6

## Self-Assessment Tools



- Performance Measures (Metrics)
- DOE Self Assessment
- Contractor Self Assessment

May Be Found at:  
<http://tis.eh.doe.gov/criticality>

McKamy 7

## Recommended Performance Metrics

- Contractor management performs self-assessments of NCS Program elements per ANSI/ANS-8.19
- Infractions should be closed in a timely manner
- Strive to avoid repeat infractions
- Criticality Safety Engineer (CSE) performs one criticality safety audit per month
- Contractor operations supervision, assisted by CSEs, audits all operational areas of the facility annually

McKamy 8



## Recommended Performance Metrics (Continued)

- Self-reporting should be encouraged
- Minimize rework
- All CSEs should be formally qualified by a specified date
- Encourage continuing professional development of CSEs

McKamy 9



## DOE Self Assessment Criteria

- Derived from DOE P 450.5 and endorsed by the Department's Criticality Safety Coordinating Team
- DOE NCS point-of-contact maintains operational awareness of contractor work activities
  - Reviews contractor NCS budgets for adequacy
  - Develops NCS Performance Metrics
  - Requires "robust, rigorous, credible, Contractor" NCS Self-Assessment
  - Reviews performance against performance metrics and contractor self-assessments
  - Appraises contractor NCS program periodically
  - Utilizes outside experts periodically (CSSG, CSCT, HQ)

McKamy 10



## Implementation of Contractor Self Assessment

- Developed from ANSI/ANS-8.19 and endorsed by the Department's Criticality Safety Support Group
- Practical Lines of Inquiry that are applicable to every site with NCS concerns
- May be implemented in phases over time to match available self assessment resources
- Proven tool – used effectively at two sites

McKamy 11



## Summary

- Sites already doing self-assessments
- Continue performing self-assessments using better criteria
- External expertise available for assistance (NCSPMT, CSSG, CSCT, EH)
- DOE Field Office and the contractor should utilize same standards-based criteria for assessments
- Recommended tools are field tested and work – **USE THEM!**

McKamy 12



# NOTES

Man's Field on Role of Facility Mgr in NCS:

- 1) Facility Mgr Owns NCS and is personally responsible for NCS should NOT push this responsibility down to Cog NCS staff.
- 2) Determining "configuration states" of the facility is as important to do in a structured way as the neutronics analysis.
- 3) Agree that ~~a~~ a crit accident is unacceptable the risk must be zero essentially  
Zero criticalities Not zero casualties  
Managing risk through shielding: admin controls and tolerating ~~the~~ the potential for criticality will NOT be tolerated by the public.  
Zero releases as well.
- 4) Ridiculously conservative assumptions in SARc analysis etc are not best practices.  
Workforce needs to understand the barriers to criticality and appreciate them as being real and useful NOT ridiculously over conservative.
- 5) Configuration Control — the risk of criticality has increased because no one knows the state of the facility today — the people are gone and the facility has changed.
- 6) Emulate INPO





