Integration of NCS in the Chemistry and Metallurgy Research Replacement Facility at LANL

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Agenda

- **Overview of the CMRR Project**
  - Broken into two phases
- **History of the CMRR project**
- **Preliminary criticality safety evaluations**
- **Engineered feature implementation**
- **Conclusions/Challenges**

Overview of the CMRR Project

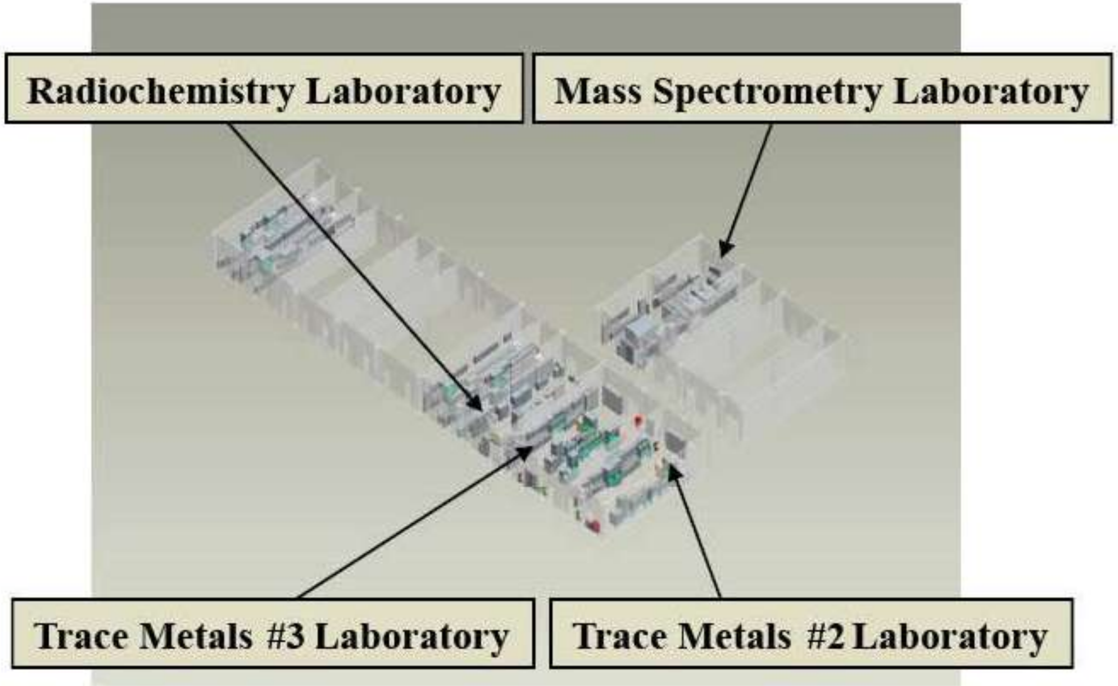
- **The Chemistry and Metallurgy Research Replacement (CMRR) is being designed to continue the mission to maintain and certify the nuclear weapons stockpile in the United States**
- **The CMR building that currently supports this mission was built in the early 1950s**
  - Exceeded its useful lifespan
- **The project is broken into two phases**
  - I – Radiological Laboratory, Utility, Office Building
  - II – Nuclear Facility

Phase I – RLUOB

- **RLUOB – Radiological Laboratory, Utility, and Office Building**
  - Nearly 20,000 ft^2 of radiological lab space
  - Training center
    - 4 classrooms
    - 2 non-rad training simulation labs
  - Centralized utility building for all CMRR facilities
  - Office space for 350 personnel
  - Facility incident command center and facility operations center

Phase I – RLUOB

- **Designed as a radiological facility**
- **No criticality safety concerns – Design guidance was limited**
  - ≤ 8.4 grams of Pu-239 equivalent
  - However….



Phase II – CMRR Nuclear Facility

- **CMRR Nuclear Facility**
  - Hazard Cat. 2, Security Cat. 1 facility
  - Single building with ~22,500 ft^2 of lab space
  - Operations include
    - Actinide chemistry and materials characterization
    - Actinide R&D activities
    - SNM vaults
    - 306 glovebox enclosures
    - Extensive material transfer system
  - ~350 new fissile material operations

History of NCS Support

- **LANL NCS group has been a member of the project team since early 2002**
- **NCS group has been working directly with facility designers and CMRR project staff**
  - Face-to-face interactions with the designers
    - ANS-8 standards, handbook data & calculations were used to support the conceptual and preliminary design stages
    - Documentation requirements prior to DOE-STD-1189 not well defined
  - As the design matured, more formal NCS guidance was provided per DOE-STD-1189
    - "To support design development, it is important to develop fundamental design criteria to address typical criticality safety concerns (e.g., safe geometry) and to incorporate these criteria early in the design process"
    - "Identify criticality safety issues early in the design process and design the facility in such a way as to preclude criticality problems"

History of NCS Support

DOE-STD-1189-2008

Actions Authorized by Critical Decision Approval						
Phase / Interface	Mission Need	Conceptual Design	Preliminary Design	Detailed Design	Construction	Resource Requirements and Guidance
Criticality Safety	• Determine criticality potential • Input to Hazard Categorization	• Criticality Control Philosophy • Criticality guidance for Design	• Preliminary CSEs • Updated criticality safety design requirements	• Updated preliminary CSEs • Re-assess criticality limits and controls based on design and operating the process/facility • CSE input to PDSA (Hazard Analysis and TSR derivation)	• Update and issue CSEs • TSRs and operating procedures will incorporate criticality controls, as developed under the guidance of DOE-STD-3007 and DOE G 423.1-1. • Validate NCS controls in field\ • Prepare DSA Ch. 6	• DOE-O-420.1B • DOE-STD-3007-2007 • DOE-G-421.1-1

LANL NCS Program Still "Expert-Based" < 2005

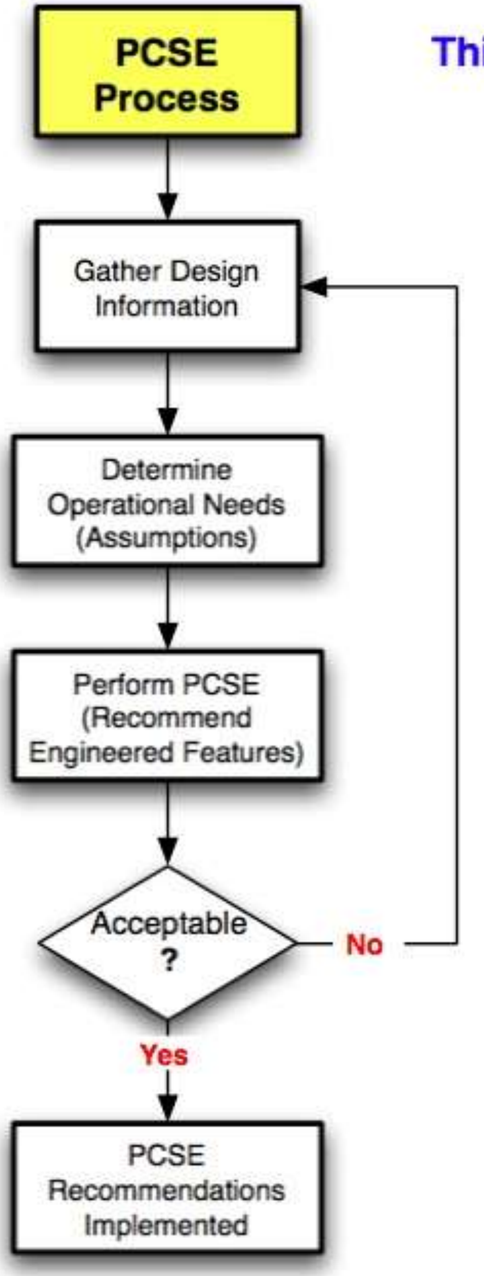
< late 2008

2009

> 2009

Preliminary Criticality Safety Evaluations

- **Audience is not only supervisors & operators**
  - Safety Basis personnel
  - Designers
  - LANL CMRR project staff
  - Regulators
- **NNSA concurrence of the preliminary evaluation process**
  - Assisted with the development of the process
  - PCSE content and limit summary tables
  - PDSA implementation process
- **Internal NCS Policy generated for the PCSE process for CMRR**
  - PCSEs are broadly written and are currently system-focused
  - Process-focused evaluations will be performed at a much later date
  - PCSEs are iterative in nature
    - Policy allows for quick revisions
    - Effective communication is essential to maximize the efficiency of the process



This process is repeated as necessary.

Preliminary Criticality Safety Evaluations

- **PCSEs are iterative in nature and are revised when**
  - Design features are changed/modified
    - Operational reasons
    - Results of the PCSE
- **NCS involvement is crucial because design features for criticality safety may not be compatible with other safety disciplines**
  - Fire protection issues
    - Water-based fire suppression in gloveboxes
  - Shielding concerns in SNM vaults

PCSE Recommendations – Summary

- Analyzed Configuration
  - Summary of the design, i.e., system drawings and system design description (SDD)
- Analyzed Design Summary
  - Information from the analyzed configuration required for the PCSE
- Safety Significant Engineered Feature Requirements
  - Required for worker safety where a single engineered feature failure could result in a criticality accident
  - Example: vault rack door latch failure during a seismic event that results in the ejection of multiple containers of fissile material from a safe to an unsafe configuration

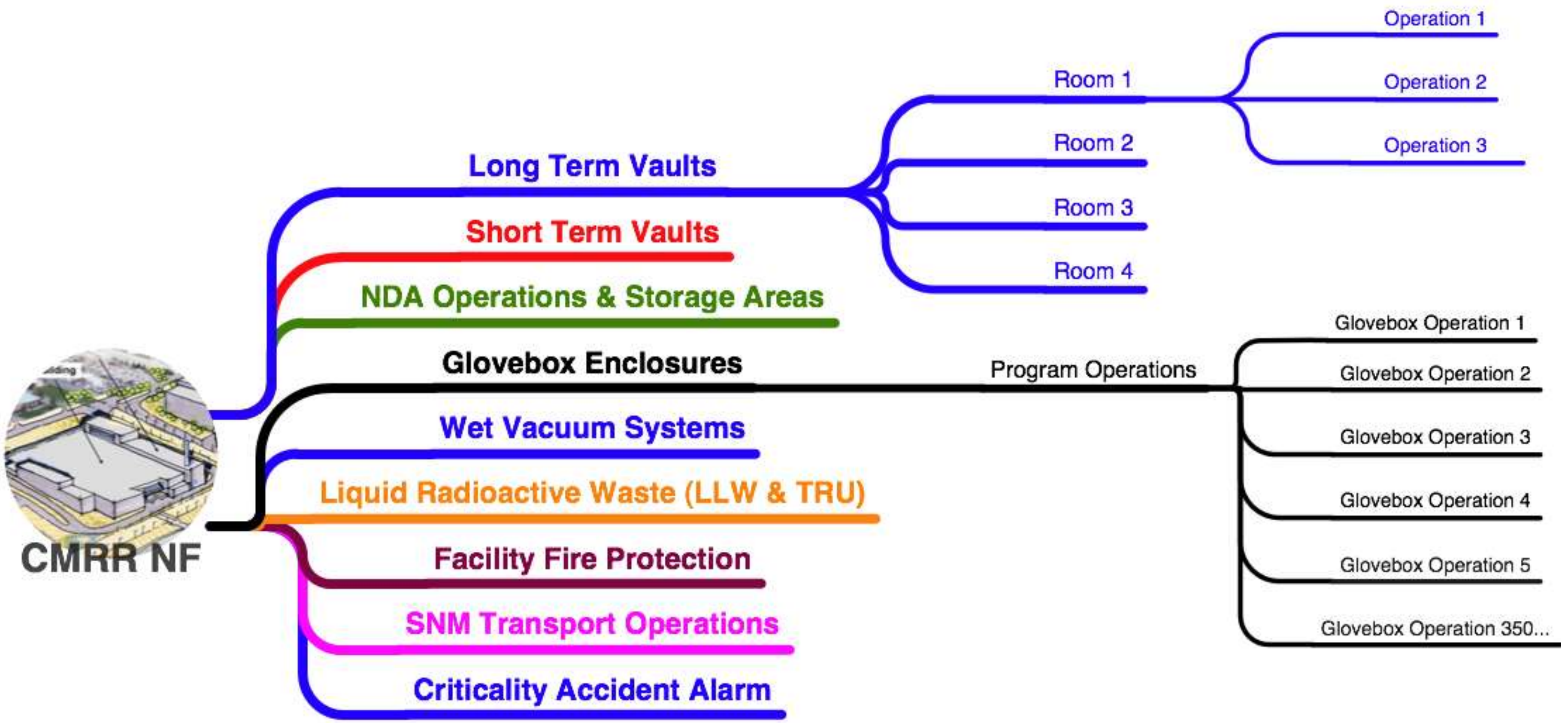
PCSE Recommendations – Summary

- Program Controlled Engineering Feature Requirements
  - Those engineered features relied upon for criticality safety margin
  - Do not rise to the safety significant level
- Defense-in-depth features
  - Those features that are recommended but not needed for criticality safety margin
- Administrative limit assumptions
  - Example: mass limits, spacing limits, etc., that are required to ensure the criticality safety margin, i.e., subcriticality for all normal and credible abnormal conditions

Preliminary Criticality Safety Evaluations

- **The following systems have been extensively evaluated so far**
  - Long and short term vaults
  - Non-destructive assay operations
  - Glovebox enclosures
  - Wet vacuum systems
  - Radioactive and caustic liquid waste operations
  - Waste drum processing and storage
  - NF fire protection concerns
  - Fissile material transport operations
  - Criticality accident alarm system guidance

PCSE Future Evolution



Engineered Feature Implementation

- **PCSE limits were generated with the help of**
  - Designers
  - Safety basis personnel
  - CMRR project staff
- **The engineered features are implemented into the PDSA**
  - Ch. 3 – Hazards analysis references PCSE
  - Ch. 4 – Safety significant engineered features are potential TSRs
  - Ch. 6 – Discussion of the LANL NCS program
- **SDDs discuss the engineered features**
  - Function as a configuration management database
  - Design changes that affect NCS will drive PCSE revisions

Conclusions/Challenges

- **CMRR project consists of two phases**
- **NCS has been integrated into the CMRR NF via PCSEs**
  - Engineered features developed with administrative limit “assumptions”
  - System description documents function as an early configuration management database
- **Effective communications between CMRR staff, DNFSB, Designers, NNSA, etc. has been the key to success**
- **Implementation of the PCSE limits remains a difficult issue**