

**[DNFSB LETTERHEAD]**

November 3, 1995

The Honorable Victor H. Reis  
Assistant Secretary for Defense Programs  
Department of Energy  
Washington, D.C. 20585-0104

Dear Dr. Reis:

Members of the Defense Nuclear Facilities Safety Board's (Board) staff recently conducted a review of the Los Alamos Critical Experiment Facility (LACEF) operations and safety analysis documentation on July 25-27, 1995. A report of this visit is provided for your information and use in the enclosed memorandum.

An area of concern to the Board is the use of Technical Specification Requirements (TSR) that predate the issuance of Department of Energy (DOE) Order 5480.22 and are critical to the safe operation of the LACEF operation. The Board's staff identified a number of items appropriate for consideration in upgrading TSRs that are currently being developed for DOE's approval.

Please contact me if you require any additional information or assistance.

Sincerely,

John T. Conway  
Chairman

c: Mr. Mark B. Whitaker  
Mr. Bruce Twining

Enclosure

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**DEFENSE NUCLEAR FACILITIES SAFETY BOARD**

August 11, 1995

**MEMORANDUM  
FOR:**

G. W. Cunningham, Technical Director

**COPIES:**

Board Members

**FROM:**

J. D. Roarty

**SUBJECT:**

Los Alamos Critical Experiment Facility Safety Analysis Report  
Review (July 25-27, 1995)

1. **Purpose:** This report documents a review of the Los Alamos Critical Experiment Facility (LACEF) Safety Analysis Report (SAR) by the Defense Nuclear Facilities Safety Board's (Board) technical staff (A Jordan and J. Roarty) and outside expert (S. Pearlstein).
2. **Summary:** The LACEF SAR appears to be satisfactory and reflects the product of technical personnel well trained in criticality operations. A deterministic analysis of operational accidents has facilitated the specification of reactivity addition rates, personnel exclusion requirements, and test control procedures that ensure safety in well-defined experimental programs. Technical Specification Requirements (TSR) currently in use predate the issuance of Department of Energy (DOE) Order 5480.29; revised draft TSRs have been completed and should be implemented as soon as possible. LACEF operations are organizationally obscure and potentially diminish the importance and assigned priority of criticality work at the Los Alamos National Laboratory (LANL).
3. **Background:** The LACEF safety analysis is unique and more closely resembles a SAR prepared to a Nuclear Regulatory Commission (NRC) regulatory guide than DOE Order 5480.23. Past safety infractions have guided the development of the safety analysis. Bounding accidents are postulated that: (a) demonstrates compatibility with on-site worker and site boundary dose limits and (b) enable the conduct of experimental programs within enveloping hazards/accident analyses.
4. **Discussion:**
  - a. Budget reductions and uncertainties have had a discernible impact on the LACEF. The staff is one-half the level that existed in 1989 and numbers about 45 people. On the LANL organizational chart, LACEF is now called Advanced Nuclear Technology and is nested in the Non-Proliferation and International Security Division with 11 other special purpose organizations.
  - b. LACEF conducts experiments in four specific areas: benchmark experiments, application experiments, basic physics experiments, and prototype device experiments. There are 15 critical assemblies for steady state, burst, and subcritical experiments.
  - c. Among the sets of experiments planned are the critical masses of  $^{236}\text{U}$ ,  $^{237}\text{Np}$ ,  $^{241,242}\text{Pu}$ , and  $^{241}\text{Am}$  for which sufficient quantities may now exist in the DOE complex for criticality, but there are no direct measurements. The material  $^{241}\text{Pu}$  is fissile; i.e., fission can be induced by thermal neutrons. The other materials are fissionable; i.e., fission can be induced only by fast neutrons having energies above  $\sim 1/2$  MeV. If a fast critical experiment is constructed of fissionable material, the "dollar" value of delayed neutrons is very small or zero due to the threshold character of the fission cross section and the soft spectrum of delayed neutrons; i.e., the delayed neutrons are mostly emitted at energies below the effective energy threshold of the fission cross section and have little or no influence on criticality. The design of critical experiments for these materials must consider the possibility that delayed criticality might be bypassed and

prompt criticality might be reached. At the present time experiments substituting  $^{237}\text{Np}$  for enriched  $^{235}\text{U}$  in FLATTOP are planned. Much of the material needed to attempt a  $^{237}\text{Np}$  critical experiment is in liquid form, and it will cost three million dollars to convert it to metal.

- d. The TSR currently approved for use is LA-6016-SOP, Rev. 2, dated September 1988, and lacks a comprehensive set of requirements as specified in DOE Order 5480.22. A new draft TSR has been completed and awaits DOE's approval. A preliminary review of this draft TSR indicated that additional requirements should be considered consistent with the present SAR assumptions:
    - Surveillance of sealed floor drains in KIVA 1 and 2 to prevent critical mass accumulation.
    - Specification of lubrication in BIG TEN assembly to avoid sparking in pyrophoric uranium.
    - Inspection of GODIVA fuel for cracking that could impede motion of the control element or safety block.
    - A KIVA 1 inventory limit of 200 kg of highly enriched uranium (HEU) since that value is used as a limit in the analysis of natural phenomenon hazards.
    - A maximum SHEBA rod withdrawal speed.
    - Pu clad integrity inspection (smears).
    - Securing of SKUA experiments to prevent movement affecting criticality.
    - Hillside vault inventory limits for Pu (10 kg) and U (100 kg).
  - e. In response to a staff question concerning the potential for hydrogen gas production due to radiolysis in fissile solutions, LACEF personnel indicated that inert gas pressure is monitored to ensure that flammability limits are not exceeded. This item is also appropriate for consideration as a TSR.
  - f. As a result of Board Recommendation 93-2, criticality experimental needs have been identified and prioritized by DOE and a Nuclear Criticality Safety Experiments Committee. Assuming there is viable DOE funding for the next fiscal year, the LACEF program is strongly linked to priority experiments.
5. **Future Staff Action:** The Board's staff plans to make follow-up visits following the DOE approval of draft test specifications. Experimental programs defined in the Board

Recommendation 93-2 Implementation Plan will be followed closely.