John T. Conway, Chairman
A.J. Eggenberger, Vice Chairman
John W. Crawford, Jr.
Joseph J. DiNunno
Herbert John Cecil Kouts

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004
(202) 208-6400

June 28, 1996

The Honorable Victor H. Reis
Assistant Secretary for Defense Programs
Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585-0104

Dear Dr. Reis:

Members of the Defense Nuclear Facilities Safety Board's (Board) staff have performed several reviews of the first scheduled subcritical experiment (REBOUND) to be conducted at the Nevada Test Site (NTS). Staff trip reports from these reviews are enclosed for your information and use.

As discussed in Recommendation 95-2 to the Secretary of Energy, the Board believes all operations and activities conducted within the defense nuclear complex that involve radioactive materials should be subject to Safety Management Plans that are graded according to the risk associated with the activity. The effort to define the authorization basis for REBOUND did not completely follow the standardized safety management approach established for nuclear facilities, nor did it follow the approach established for nuclear explosive operations. In addition, neither approach was tailored to the unique characteristics and hazards of this experiment.

Although the hazards associated with REBOUND appear to have been adequately addressed by the approach developed by the Los Alamos National Laboratory, the Board believes that both the Department of Energy (DOE) Headquarters and the Nevada Operations Office need to develop a comprehensive Safety Management Plan that would address the full range of potential hazards associated with the complete suite of future subcritical experiments at NTS. DOE's active participation in developing such a plan, in cooperation with both of the nuclear design laboratories fielding the subcritical experiments, is essential for the safe management of these experiments at NTS.

The Board and its staff will continue to closely monitor the conduct of subcritical experiments at NTS.

Sincerely,

John T. Conway
Chairman

c: Mr. Mark B. Whitaker, Jr.
Mr. Terry Vaeth

Enclosures

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

March 4, 1996

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: Dermot Winters
Roger Zavadoski

SUBJECT: Trip Report - Containment Review Panel Review for LANL Subcritical Experiment, REBOUND-1

1. **Purpose:** This report documents observations made by Defense Nuclear Facilities Safety Board (Board) staff members Dermot Winters and Roger Zavadoski during a trip to the Nevada Test Site (NTS) and the Department of Energy Nevada Operations Office (DOE/NVOO) on February 27-28, 1996, to observe the newly formed Containment Review Panel's (CRP) review of plans for the conduct of the Los Alamos National Laboratory's (LANL) subcritical experiment, REBOUND-1.

2. **Summary:** On February 27, 1996, the Board's staff accompanied members of the CRP during their pre-meeting observational tour of the LYNER tunnel facility at the NTS where REBOUND-1 is planned for mid-June. On February 28, 1996, the Board's staff observed the CRP's meeting on REBOUND-1 held at DOE/NVOO. This was the initial meeting of the CRP, which has been newly formed for the purpose of evaluating the containment of subcritical experiments at the NTS. REBOUND-1 is the first of six subcritical experiments planned for the LYNER facility in 1996 and 1997. Although the Board's staff has concerns over the degree of independence of the CRP, the staff agrees with the CRP conclusion that no leakage of plutonium from the experimental room is to be expected.

3. **Background:** REBOUND-1 is a subcritical experiment to measure equation-of-state properties of weapons-grade plutonium. Safety concerns deal with the potential for release of plutonium from the experiment from the REBOUND-1 experiment room, since the quantities and configuration of the plutonium used in this experiment preclude any criticality hazard. Because the plug being utilized to seal the room is far too massive and well anchored to be moved by the force of the explosive charges being employed, the concern is that plutonium dusts or fumes might pass through penetrations for diagnostics to be installed in the plug, along the contact between the plug and the tunnel walls, or through pore spaces or fractures in the alluvial rock formation surrounding the plug. An earlier experiment, KISMET, had unexpectedly released carbon monoxide gas generated from the explosives used. Apparently the gas escaped the KISMET experiment room through the alluvial rock formation in the tunnel walls surrounding the plug.

4. **Discussion/Observations:** The CRP and DOE/NVOO are continuing to fine tune the CRP Charter. The CRP had not, as of their meeting on February 28, fully defined containment goals for REBOUND-1 and future subcritical experiments. The CRP Charter, as currently written, has intentionally created a "collegial" role for the CRP, in contrast to that of the Containment Evaluation Panel (CEP). This approach is being taken, at least in part, due to the decreasing number of personnel at the national laboratories available to work on nuclear weapons activities. The CEP has existed to evaluate the containment of underground nuclear detonations, and its Charter makes it fully independent of the containment design process. Nevertheless, the CRP's role, at least for REBOUND-1, does not appear to be detrimental to safety and seems consistent with the concept of a graded approach since these experiments will not involve nuclear detonations. However, this issue may need to be reexamined in the future if subcritical experiments with K(eff)'s more closely approaching 1.0 are fielded.

   The containment design for the experiments are derived from weapons testing containments. As such the design is more than adequate for any combination of subcritical assemblies and high explosives. For this reason and for the reasons described below, the CRP prospectus has concluded there is no leakage of plutonium expected from the REBOUND-1 experiment room. The CRP members, at the conclusion of their February 28, 1996 meeting, all agreed with that conclusion. The Board staff believes the CRP's conclusion is correct.

   Although the KISMET experiment leaked carbon monoxide gas around its 10-foot plug, there was no detected leakage of either the depleted uranium used or of the tungsten fines used to simulate the potential airborne transport of plutonium. The REBOUND-1 plug has been constructed 20 feet in length. This increases the path length for gaseous transport through the rock in the tunnel walls. Since geologic mapping has indicated that the usual maximum lateral extent of sedimentary channel features which potentially act as conduits for porous flow are on the order of 5 feet, increasing the plug length to 20 feet is likely to preclude even the carbon monoxide gas leak experienced in KISMET. In addition, unlike KISMET, a shotcrete grout surface has been sprayed onto the walls and roof of the experiment room (except for the rear face opposite the plug) and then painted with a mixture of Lucite paint and sodium silicate. It is believed that this covering will have the effect of increasing the gas travel path by an additional 20 feet. Past experience indicates that this coating is unlikely to be significantly damaged by the detonations.

   Further precautions to prevent gasses from passing through or around the plug are also being taken. Elaborate gas blocks along the diagnostics cable ways will be constructed employing multiple layers of special materials including Sulfaset (an expansive grout material prepared from 90 % $CaSO_4$ and 10% portland cement), Vistanex (a highly viscous proprietary material that flows into the smallest pore spaces and crevices), paraffin wax, and cement grout. Also, to ensure good adhesion between the metal components of the plug and the grout fill, all metal surfaces were pre-coated with "roughcoat," an epoxy-sand mixture. In addition, holes have been drilled 3-4 feet into the alluvial rock formation surrounding the plug and will be used to

pressure grout the formation first with a cement grout and second with a chemical grout (sodium silicate). This grouting operation will serve to reduce the permeability of the surrounding rock and further decrease the likelihood for the escape of gasses via this pathway. Grout pressures will be maintained well below pressures known to initiate hydrofracturing.

To check the efficacy of the plug and pressure grouting program, the experiment room will be pressurized with compressed air following completion of construction. If air leakage is detected remedial actions will be taken. As an additional protection against possible leakage, shortly before executing the experiment the tunnel outside of the plug will be pressurized. This will result in an increased gas pressure in the rock formation pores that will act to retard leakage from the experiment.

Beyond the experiment room, two additional tunnel plugs provide secondary and tertiary containment. Neither the secondary nor tertiary containments have been designed with installed atmospheric cleanup filters. If it should become necessary, a portable type system could be easily added.

5. **Future Staff Actions:** The Board's staff will continue to follow and observe all containment activities associated with REBOUND-1 through post-experiment evaluation of containment performance. In the interim, additional containment-related documents have been requested and will be reviewed as received. Concerns, if any, noted by the staff as a result of the document reviews will be brought to the attention of the Board.

   An area for future staff follow up is containment design for the U1g borehole where diagnostic cables and ventilation air enter the LYNER facility. This surface access hole is not protected by the secondary and tertiary containment and could present a potential weakness for experiments with K(eff)'s approaching 1.0.