September 12, 1995

**DEFENSE NUCLEAR FACILITIES SAFETY BOARD**

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| **MEMORANDUM FOR:** | G. W. Cunningham, Technical Director |
| **COPIES:** | Board Members |
| **FROM:** | C. H. Keilers, Jr. |
| **SUBJECT:** | Nevada Test Site - Review of Test Activities and Readiness |

1. **Purpose:** This report documents a review of test activities and recent exercises at the Nevada Test Site (NTS). The review was performed by D. Owen, J. Roarty, J. Preston, C. Martin, C. Keilers, and J. Collins (outside expert) of the Defense Nuclear Facility Safety Boardµs (Board) staff and was conducted on-site during the KISMET and KUCHEN exercises, February 13 to March 1, 1995, and July 31 to August 10, 1995, respectively.

2. **Summary:** Future full-scale nuclear testing in the United States is unlikely, under the Comprehensive Nuclear Test Ban Treaty being negotiated, unless the United States were to exercise the "supreme national interest clause," as a result of an unanticipated problem in the enduring stockpile.

   At this time, the Department of Energy (DOE) has not decided how and to what degree to maintain a testing capability that would support exercising the supreme national interest clause. Detailed staff observations on the exercises and test readiness are provided in the attachment.

3. **Background:** In December 1993, the Board issued Recommendation 93-6, *Maintaining Access to Nuclear Weapons Expertise in the Defense Nuclear Facilities Complex.* Although, nuclear testing was under a moratorium, part of this recommendation focused on ensuring that capability is maintained to safely conduct nuclear test operations if such operations are to be done. Subsequently, the Board accepted DOE's proposed implementation plan. DOE intends to submit a revised implementation plan this fall.

   In the last two years, the staff has observed several NTS exercises and assessed the site's capabilities to safely conduct nuclear tests. In September 1994, the Board provided DOE with observations following the BASEBALL exercise[1] and suggested that DOE consider incorporating options into the test exercise program including: (1) critical to safety that each exercise should test and reinforce, (2) quantitative assessment of the achievement of the objectives, and (3) use of trained independent observers/evaluators to critique performance. In a letter to the Board dated December 6, 1994, DOE agreed with the Boardµs suggestions.

4. **Discussion:** Major staff observations are as follows:

   a. The observed activities on D-1 and D-day for both KISMET and KUCHEN were

formal, professional, and well-coordinated. However, other aspects observed during these two exercises warrant improvement, including formality of procedures during assembly operations; exercise fidelity during insertion and emplacement; radiological simulation during re-entry operations; and full utilization of all training opportunities available, such as dry runs. More details are provided in the attachment.

b. The LANL KISMET exercise completion report is a thorough effort and documents several possible improvements. This report also identifies several concerns including availability of experienced evaluators; reduced site infrastructure (e.g., crafts, materials, laboratory permanent party); and the long periods between full-scale exercises.

c. Some improvements in conduct of exercises have been made; for example, the use of trained observers/evaluators. The staff observed that DOE has not yet incorporated formal definition of skills critical to safety that each exercise should test and reinforce and assessment of the achievement of the objectives into the test readiness program, as agreed by DOE in responding to the Boardµs letter on the BASEBALL exercise.

d. Although KISMET and KUCHEN activities exercised most operations involved in a nuclear test, several key operations were either simulated or not done at all, including testing-specific Nuclear Explosive Safety Studies (NESS); the D-7 safety review meeting; pre-mortem mechanical design meeting; full-scale area control procedures; aerial operations and cloud sampling; and drillback. DOE likely retains some capabilities in these areas, but it is difficult to assess whether the capability to safely perform these operations is being maintained with planned exercises. For drillback operations in particular, DOE has identified to Board staff that DOE does not intend to exercise that capability in future planned exercises.

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[1]DNFSB (J. T. Conway) ltr to DOE (V. H. Reis), dated September 21, 1994.

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**Attachment**
**DNFSB Staff Review of NTS Test Readiness Exercises - KISMET and KUCHEN**

1. **Introduction:** This attachment describes recent simulated nuclear test exercises (KISMET and KUCHEN) at the Nevada Test Site (NTS) and provides staff observations.

2. **Description of the LANL KISMET Exercise:**

   KISMET, a LANL combined experiment and exercise, was conducted in February and March 1995 with the following objectives:

- verify the new "Lyner" underground tunnel complex design and operation
- develop underground imaging techniques
- test the new fiber optic firing system
- investigate the distribution of heavy metal through the native alluvium
- exercise the skills of the key position personnel to safely support nuclear testing

The KISMET device was assembled in Area 27 and consisted of 50 lbs of high explosive with embedded depleted uranium oxide. After assembly, the device was transported to the Lyner underground test complex and installed in a side-tunnel (i.e., a drift), approximately 970 feet below the surface. The drift was then plugged with a 10 foot thick grout plug, and the device was detonated. Several weeks later the grout plug was mined through, and the chamber was re-entered. The staff observed device assembly (J. Roarty, J. Collins), insertion and emplacement preparations (C. Martin, J. Collins), and execution (D. Owen, J. Collins).

3. **Description of the LLNL KUCHEN Exercise:**

KUCHEN (phase 2) was a LLNL combined exercise and experiment conducted in August 1995 with the following objectives:

- compare seismic signals to those measured during other phases of the experiment
- exercise the critical skills of key position personnel and access capabilities to safely support nuclear testing

The KUCHEN device was assembled in Area 27 and consisted of 110 lbs of high explosive. After assembly, the device was transported to the test location (i.e., "ground zero"), checked, and installed down-hole approximately 210 feet below the surface in a cavity. The hole was then plugged with an inflatable seal and sand and the device was detonated. The staff observed device insertion and emplacement (C. Keilers, J. Preston, J. Collins), dry runs and execution (C. Keilers, J. Collins), and ground-zero reentry (J. Collins).

4. **Staff Comments and Observations:**

*Areas of satisfactory Performance or Noted Improvement:*

a. The observed activities and briefings on D-1 and D-Day for both exercises were formal, professional, and well-coordinated between DOE Nevada Operations Office, the laboratories, the site contractors, and the other government agencies involved.

b. Proper conduct of operations was observed during the execution phase of both these exercises. For the LANL exercise (KISMET), a temporary loss of both commercial and emergency power at the Control Point (CP-1) occurred about

one hour before execution. Site personnel expediently diagnosed and corrected the problem. For the LLNL exercise (KUCHEN), both the final dry-run and the actual execution appeared flawless from a safety standpoint.

c. The LANL (KISMET) exercise completion report is thorough and, overall, has valuable lessons learned, some of which are safety-related and worth considering for future exercises. The staff will review the LLNL exercise report when it becomes available.

d. Both the LANL and (to a greater extent) the LLNL exercise plans clearly identify key personnel in training.

e. Use of checklists appears to be increasing.

*Areas Requiring Continued Improvement:*

a. *Nuclear Explosive Safety Studies (NESS):* The 1994 independent Nuclear Explosive Safety Study (NESS) review[1] observed that the NTS NESS program "currently includes some individuals who are relatively young and inexperienced.... The suspension of testing has also caused a downsizing of the number of safety experts available for NTS activities. These factors have made it more difficult for the responsible organizations to maintain a level of qualification for NESSG members..." (Finding D6). Since no NESS has been done for simulated nuclear testing for at least the last year, improvement in this area is not evident.

b. *Evaluators:* Ensuring access to qualified, independent evaluators for exercises will continue to warrant attention. For both the LANL and LLNL exercises, the evaluators appeared well-qualified and included retirees and experts from the other laboratory.

However, the KISMET completion report identifies a concern that funding and loss of expert personnel through retirement constrained the availability of evaluators[2].

c. *Assembly Operations:*

1. During the LANL device assembly (KISMET), the staff observed two deviations from the approved assembly procedure that raise questions about the fidelity of the exercise and the formality of following approved procedures. The staff did not observe the LLNL KUCHEN exercise assembly since it did not simulate a nuclear assembly operation.

One KISMET deviation observed was the use of a different shim technique during assembly. In the second case the device, mounted on a cart, was moved using a forklift; however, the cart was not certified for use with the forklift. The decision to do this was made locally, based on

the device not being a live nuclear assembly.

2. The Device Assembly Facility (DAF) is approaching completion and could be ready for nuclear explosive operations early next year. This facility has upgraded safety features, including gravel gerties, and is intended to replace the Area 27 facilities historically used for test device assembly. However, at this time, DAF has no complementary mission that would be consistent with the anticipated Comprehensive Test Ban Treaty while also maintaining the facility's capabilities and personnel skills.

d. *Insertion and Emplacement:* During the LLNL device insertion (KUCHEN), the staff observed several apparently non-standard practices, which raise doubts about the fidelity of this part of the exercise. The staff did not observe the LANL (KISMET) installation but did have similar observations during the SHORTCAKE insertion exercise in June 1994.[3] Therefore, it is apparent to the staff that readiness for nuclear device insertion and emplacement is not being maintained.

   The staff observed that the exercise personnel treated the high explosive device with due respect. However, by not performing or simulating the additional operations and precautions for a *nuclear* explosive device, the exercise's benefit is diminished. Some apparently non-standard practices observed during the LLNL insertion are as follows:

   1. After arrival at ground zero, the device was lifted by a crane and transferred to the top of the hole. A rigger used a rope to control its position during this transfer and had to pull the device to one side to clear a second, smaller crane.

      Although the rigger had control of the device at all times, the staff believes that, had this been a nuclear test device, pre-planning required for a critical lift would have identified the second crane as a potential interference and it would have been repositioned before the transfer.

   2. During device insertion down-hole, the device was suspended by a pipe and detonation/instrumentation cables were banded periodically along the pipe as it was lowered. At one point, a worker removed a banding strap from around the pipe by using a cold chisel: first chiseling from each side and then perpendicular to the pipe. It is not clear if this would be acceptable practice during an actual nuclear device insertion.

   3. As observed by the staff during the SHORTCAKE exercise, some housekeeping and personnel control practices during insertion were substandard. Tools were used that were not "captured" to prevent them from falling in the annulus. After the device was well down the insertion pipe, personnel were observed to be smoking near the hole, which was not completely protected against falling objects.

e. *Dry Runs:* For the LLNL exercise (KUCHEN), the staff observed four of the sixteen (estimated) dry runs done prior to D Day. For the most part, these went smoothly. However, the staff has some specific observations:

1. The training opportunity presented by these dry runs does not appear to be fully utilized, although the staff recognizes that dry runs are intended primarily to test the operability of systems. Other than the final dry run, the staff did not see any observers, evaluators, or trainees. For the most part, the dry runs were handled as routine.

2. There are not a large number of trained and qualified control room operators. The LANL exercise completion report identifies the importance of dry runs for significant safety-related activities, partly because of the availability of fewer experienced operators[4]. Also, during one KUCHEN dry run, a LLNL control room operator (a key position) was absent. A LANL operator, qualified for a different control room, had to be substituted. This was also the only time LANL staff was observed participating in the LLNL exercise, other than as evaluators.

3. During the dry run with the substitute operator, the operator had to be prompted by a phone call from the Red Shack to remotely secure air conditioners in trailers at ground zero. This step supported the seismic experiments and had no bearing on safety. However, it does appear that improvements could be made to ensure that qualified operators, including substitutes, are able to complete all steps required to safely and successfully complete a test. Also, this experience does lend greater emphasis to the need to use dry runs to train additional operators.

f. *Re-entry Radiological Conditions:* No radiological conditions were simulated as part of the LLNL exercise (KUCHEN) re-entry to ground zero. On the positive side, close attention was provided to entry team control, communications to the technical director, and expected re-entry hazards (e.g., potential toxic gases and electrical grounding).

The staff did not observe re-entry for the LANL exercise (KISMET). However, in a previous exercise (BASEBALL, June 1994), the staff did observe attempted but inadequate field simulation of radiological conditions[5]. Since no field simulation was attempted for KUCHEN, this is not an area of apparent improvement.

g. *Engineered Safeguards:* Safety during nuclear testing operations remains highly dependent on human actions. As part of the implementation of Board Recommendation 93-6, DOE completed a study on whether traditional administrative controls to ensure nuclear explosive safety at NTS is adequate given the loss of experienced personnel[6]. This study recommended that the current safety systems at NTS be supplemented with engineered safeguards that are being developed by the laboratories. These improvements should become increasingly evident in future exercises.

h. *Quantitative Risk Assessments:* In a recent letter[7] on proposed changes to the DOE nuclear explosive Orders the Board stated that, "although the estimates of the absolute value of risk may be doubtful in this application, the Board believes that quantitative risk assessment is a valuable tool for identifying relative risk contributors in a decision-making process and efforts should continue to use this technology."

   Test readiness exercises provide a unique opportunity to obtain data supporting such assessments, perhaps by having the analysts observe the operations. This was not observed to occur during these exercises, but may be worthwhile in the future.

i. *Containment:* The LANL KISMET completion report indicates that higher than expected amounts of carbon monoxide (a flammability concern) were measured in the LYNER facility after the detonation and that there were leak paths through the primary containment plug and surrounding alluvium. If this had been a nuclear test, not only carbon monoxide but also radioactive gases might have escaped (provided the residual containment stresses were inadequate to produce an effective seal). LYNER containment may warrant increased attention in future exercises.

j. *Distraction by Oversight:* In the KISMET completion report[8], one evaluator observed that: "The presence of oversight personnel during device assembly operations is a detriment to nuclear explosive or high explosive safety." This evaluator recommended that: "The professionalism of the assembly team personnel should be recognized and unnecessary oversight kept to a minimum."

   The staff has been performing oversight of these types of operations at Pantex for some time now. The staff recognizes the professionalism and experience of the assembly team, but considers that oversight of these operations is required and, based on NRC experience, may actually improve performance effectiveness by providing a certain amount of stress[9].

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[1]DOE DP-21 Report, "Department of Energy Nuclear Explosive Safety Study Final Report," 94:2411, April 13, 1994.

[2]"KISMET Experiment/Exercise Completion Report", 95:2976, pp 7, June 2, 1995.

[3]Tontodonato, R.E., "Trip Report on DNFSB Staff Review of Methods for Emplacing Nuclear Devices in Underground Testing," 94:6146, August 17, 1994.

[4]"KISMET Experiment/Exercise Completion Report", 95:2976, pp 13, June 2, 1995.

[5]Attachment to DNFSB (J. Conway) Ltr to DOE (V. Reis), 94:5157, Sept 21, 1994.

[6]DOE DP-21 Report, "An Evaluation of Administrative Controls for Nuclear Explosive Safety at the Nevada Test Site," 95:2966, April 28, 1995.

[7]DNFSB (J. Conway) ltr to DOE (V. Reis), 95:3658, July 25, 1995.

[8]"KISMET Experiment/Exercise Completion Report", 95:2976, pp H-20, June 2, 1995.

[9]"Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Applications," NUREG/CR-1278, August 1983.