DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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September 29, 1994

Mr. Mark Whitaker, EH-6
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585

Dear Mr. Whitaker:

Enclosed for your information and distribution are eight (8) Defense Nuclear Facilities Safety Board (DNFSB) staff reports. The reports have been placed in the DNFSB Public Reading Room.

Sincerely,

George W. Cunningham
Technical Director

Enclosures (8)

94-0005337

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

April 7, 1994

MEMORANDUM FOR: G. W. Cunningham

FROM: Sol Pearlstein

SUBJECT: Trip Report on Recovery of SNAP Fuel from Corroding Fuel Cans in the CPP-603 South Basin, March 22-23, 1994

1. **Purpose:** This memorandum documents a review of the plans for the CPP-603 South Basin SNAP fuel recovery at the Idaho National Engineering Laboratory (INEL). The review was conducted by Sol Pearlstein of the Defense Nuclear Facilities Safety Board (DNFSB) staff at the DNFSB offices and during a trip to INEL on March 22-23, 1994.

2. **Summary:** The repackaging steps appear safe but must be carried out in a specific order to assure safety. The CPP-603 design experiences may be applicable to repackaging plans at other DOE sites.

3. **Background:** Several of the aluminum storage cans containing SNAP fuel are corroding. The repackaging of the fuel into stainless steel cans and storage in a stainless steel rack is planned. The retrieval apparatus is intricate because a goal of the operation is to prevent loose pieces of fuel from being dropped on storage racks or the floor of the basin. The retrieval apparatus and procedures have been tested and as of March 24, 1994, one more practice run was to be completed before beginning the recovery of SNAP fuel.

4. **Discussion:**

   a. Location and Condition: SNAP type fuels are stored in the CPP-603 South Basin. The fuel consists of cylindrical rods of approximately 1/2 to 1 1/4 inches in diameter that were mechanically declad and placed in aluminum cans for storage under water. Some of the rods may not have been completely declad. The rods at the beginning of life consisted of fully enriched uranium with zinconium hydrided to form UZrH. SNAP fuel originating from Atomics International (AI) is contained in 2-inch diameter aluminum cans designated as AI Cans. Other fuel is contained in 3.5-inch diameter aluminum cans designated as SNAP cans. The rods, if unbroken, are 10 to 17 inches in length and two or more rods are fit side-by-side within the same can depending on the diameter and up to three rod heights are stacked within each storage can. It is expected that at least some rods are broken into short lengths as a result of the decladding or packing into cans. The AI cans have been stored in water for almost 20 years and the SNAP cans for more than 25 years.

Sections of the aluminum storage racks show extensive corrosion evidenced by severe pitting and discoloration. Some of the storage cans show the same effects but it is not known for sure whether their integrity is destroyed. It is unlikely that the fuel rods are seriously corroded since no significant amounts of uranium have been found in samples of water near the storage racks or in silt from the basin floor.

b. <u>Repackaging Plan:</u> The repackaging plan consists of the following steps:

1. Stainless steel decoupling sheaths are inserted around full cans to reduce overall criticality level about 3%.

2. A large containment can about 4 feet in diameter is placed over the section of the fuel storage rack containing corroding fuel cans. The containment can has circular openings in the bottom that can be plugged or used for fuel repackaging efforts. All repackaging of fuel takes place within or below the containment can. The containment can also has a removable side section to allow movement of fuel cans to other basin areas.

3. Crescent shaped holes in the rack below a corroding can is plugged by a special clamping apparatus introduced through unoccupied storage tubes. This prevents material from falling to the basin floor should loose fragments result from lifting a corroding fuel can.

4. With decoupling sheaths removed, a removal sleeve is inserted around a corroding fuel can. The sleeve is inserted in two steps; the first piece surrounds the fuel can approximately 270° and the second piece completes the lateral enclosure. The first piece contains an inside hinged flap that can drop to form a bottom to the removal sleeve once the fuel can has been lifted 7 inches. This prevents loose material from falling out of the removal sleeve.

5. The removal sleeve containing the corroding fuel can is lifted out of the storage tube and positioned above a clean storage tube containing a stainless steel repackaging can. The sleeve containing the fuel can is lowered fully into the repackaging can. The corroding fuel can is raised 7 inches relative to the retrieval sleeve allowing the trap door to be raised and the retrieval sleeve to be withdrawn.

6. If, during any part of a repackaging operation, fragments of aluminum or fuel drop from a corroding can, these pieces will be retrieved by special tools and placed in the repackaging can before proceeding.

7. A stainless steel lifting cap is screwed to the top of the repackaging can. The repackaging can is lifted from the temporary storage location and moved to a stainless steel storage rack located in the CPP South Basin.

c. Criticality Analysis: Criticality calculations were performed for several configurations of failed cans in adjacent ports and decoupling sheaths removed. Acceptable safety margins required calculated keff's to be 0.95 or less. For some scenarios, e.g. adjacent ports with three or more failed cans in a row or five failed cans in a row with decoupling sheaths around the 3rd and 5th cans only, gave calculated keff's of 0.98 and higher. Consequently, a sequence of recovery was established that would prevent subcriticality safety limits from being exceeded.

d. Status: As of Thursday, March 24, 1994, the equipment for repackaging the 6 inch corroding fuel cans had been tested, debugged, and trial runs completed. One more trial run using dummy components was planned before attempting to repackage corroding fuel. The least corroded fuel cans would be repackaged first to avoid complications at the very beginning and to thin the fuel density around the most problematic areas..

e. Comments:

1. Several engineering changes were made near the final stages of trials following suggestions by technicians. According to answers to my questions, it appears that their "Value Engineering" approach includes all disciplines in a pre-engineering discussion. The principal issues were engineering improvements requested by technicians, clarification and simplification of operational procedures, and independent verification of steps completed. The frustration in this task led to a reduction from two 12-hour shifts to one 12-hour shift of an elite crew drawn from several crews until the task is debugged.

2. Criticality analysis did not appear to consider the possibility of slurry fuel mixtures as a result of extensive corrosion of the fuel rods. This seems warranted since no significant amounts of fuel were detected outside the fuel cans. In cases of extensive fuel can corrosion, slurry fuel mixtures should be considered in the safety analysis because of the potentially increased criticality hazard. Repackaging of fuel at other sites where severe corrosion has taken place may proceed only after the consideration of the possibility of slurry fuel mixtures in cans and on the basin floor.

3. The nuclear interaction between adjacent fuel cans is reduced by the water separating them. Reducing water density could increase reactivity. There were no administrative controls prohibiting the use of air hoses in the vicinity of fuel cans without the cognizance of criticality engineers. Long hollow tubular tools are extensively used in the repackaging operation. Small holes are placed at intervals along the tubes to allow water to displace air when inserted into the pool and thus eliminate both a buoyant force on the tool and a void near the fuel.

4. Fuel recovery operations can contain more unknowns than a critical experiment. Although conceivable accident scenarios have been analyzed there is always the possibility of omissions and miscalculations. Unlike a critical experiment which contains radiation detectors to signal increases in reactivity, no instrumentation is routinely available to indicate subcriticality or changes in reactivity during repackaging operations. (Ivon Fergus of DOE's Office of Nuclear Safety is promoting the use of ^{252}Cf noise analysis techniques for subcritical measurements.)

5. Repackaging of corroding fuel is necessary at several DOE sites. Complex engineering design is necessary to contain the corroding fuel during repackaging. A meeting to exchange information of the design teams from each of the sites preparing to repackage fuel would be mutually beneficial.

References:

a. CPP-603 South Basin SNAP Fuel Recovery, Safety and Technical Justification Phase "B" Retrieve, Package and Restorage-Draft, February 14, 1994.

b. Safety Evaluation of CPP-603 South Basin USQ Recovery Phase B - SNAP/AI Fuel Repackaging and Relocation, March 4, 1994.

c. Unclassified Fuels in the CPP-603 Fuel Storage Basins, B. Palmer, Ed., March 1994.