95-0001232

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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February 22, 1995

Mr. Mark Whitaker, EH-9
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585

Dear Mr. Whitaker:

Enclosed for your information and distribution are 13 Defense Nuclear Facilities Safety Board staff reports. The reports have been placed in our Public Reading Room.

Sincerely,

George W. Cunningham
Technical Director

Enclosures (13)

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

August 24, 1994

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: Davis Hurt

SUBJECT: Plutonium Storage at Lawrence Livermore National Laboratory

1. **Purpose:** This report documents a visit by DNFSB Staff member Davis Hurt and outside expert Joseph Leary to Lawrence Livermore National Laboratory (Livermore) on August 17 and 18, 1994, to review plutonium storage practices.

2. **Summary:** The Staff did not find any major plutonium storage problems at Livermore. There was a recent incident involving bulging cans of plutonium-bearing ash, but the Staff does not believe it indicates a general problem. Livermore has some excellent plutonium processing glove boxes that could be used (with modest modifications) to package plutonium oxides and metals to conform to the draft Department of Energy (DOE) standard.

3. **Background:** Livermore has the fifth largest inventory of separated plutonium in the DOE complex. The unclassified inventory is 400 kilograms, although it is public knowledge that some plutonium has been shipped to other sites since that figure was released. The four DOE sites with more plutonium than Livermore are Rocky Flats, Hanford, Los Alamos National Laboratory (LANL), and the Savannah River Site (SRS).

4. **Discussion:**

   a. An Overview of the Livermore Plutonium Inventory: Livermore regularly fabricated experimental pits from plutonium metal received from SRS or LANL. Also, some pits from dismantled weapons were sent to Livermore for examination and plutonium recovery experiments. Livermore also received a large amount of reactor-grade plutonium for use in the Advanced Laser Isotope Separation (AVLIS) program. The great majority of Livermore's plutonium is located in vaults in Building 332. About one-fifth of their plutonium, mainly the AVLIS material, is reactor grade.

   DOE is consciously trying to reduce the amount of plutonium at Livermore. As of the mid-1980s, Livermore's "administrative limit" was 700 kg. It was subsequently agreed that the future administrative limit would be reduced to 200 kg, which is the amount Livermore personnel think they will need for prospective research and development. The target date for reaching the lower inventory was the end of FY93. The 200 kg goal has not been reached because of reluctance by Hanford to accept some of the surplus

plutonium. About two-thirds of the 500 kg surplus has been shipped; the other one-third is packaged for shipment but still stored at Livermore.

The plutonium materials stored at Livermore include pits, half-pits, metal buttons and ingots, small metal samples, oxides, hydrides, chloride and fluoride salts, Rocky Flats-type scrub alloy, ash, and pyrochemical salt residues. Most of the salt residues have been scrubbed to remove a majority of the plutonium. Livermore does not store plutonium solutions, although there might be a few small solution samples in the laboratories at any given time. There are no plutonium-contaminated ion-exchange resins in storage. Livermore apparently generated relatively little plutonium-rich combustible scrap, such as rags and filters; what little was generated was burned in furnaces or on hot plates before it accumulated. There is a written prohibition on storage of pyrophoric forms of plutonium, defined as chips, turnings, or thin metal plates, for more than 72 hours. The prohibition does not mention plutonium hydride, and several kilograms of hydride might be kept for days or weeks in argon-atmosphere glove boxes. There is no hydride stored in the vaults.

Livermore's packaging methods are fairly conventional. Plutonium oxides and ash are normally packaged in screw-lid cans, that are bagged out and overpacked in airtight crimped-lid (food-pack) cans. Most plutonium metal items (other than pits and half-pits) are packaged in a crimped-lid can, bagged out, and overpacked in another crimped-lid can. Pits are usually stored in the normal ALR-8 drums. Half-pits and some other pieces of metal are wrapped in aluminum foil, bagged out, and placed in a can. The items awaiting shipment to other sites are packaged as specified by the prospective receivers, most commonly in double crimped-lid cans.

b. The July 1994 Incident: Livermore was planning to ship an accumulation of plutonium-bearing ash to SRS for processing. The ash came from miscellaneous combustible scrap that had been burned in furnaces or on hot plates over the past several years. There were no particular controls on the temperature or hold time for burning, but the ash had been stored for several years without incident. The average plutonium content of the ash was 24 weight percent, although it varied a great deal from can to can.

In order to accommodate SRS's packaging requirements, Livermore had to repackage the ash. The original packaging consisted of screw-lid containers inside plastic bags inside crimped-lid cans. SRS wanted double crimped-lid cans and also wanted the ash consolidated into the smallest possible number of cans to economize on vault space. The repackaging started about one year ago and finished a few months ago.

It took 108 cans to hold the consolidated ash. These cans were in one of the Building 332 vaults awaiting shipment when workers noticed that two cans were bulging. The bulging

cans were placed in an inert-atmosphere glove box. A few days later, workers found two additional bulging cans, that were also placed in the glove box. That left 104 normal-looking cans in the vault. Livermore decided to examine those by X-ray to ascertain the condition of the inner cans. Twenty-two cans were selected, more or less at random, and four showed bulging inner cans. Those four were also placed in the inert-atmosphere glove box.

Gas samples have been taken from the eight bulging cans and the cans have been vented. The gas samples vary considerably, probably because of the variable content of the ash. Three cans contained very high concentrations of hydrogen (as high as 50 volume percent). Some cans were oxygen deficient (0 percent) and some were oxygen rich (29 volume percent). Some cans contained modest concentrations of methane or nitric oxide. The plan is to vent all remaining ash cans inside the glove boxes without taking any further gas samples. Livermore will do a detailed chemical analysis of the ash itself.

c. Glove Boxes: It was interesting to find that Livermore has a set of argon-atmosphere glove boxes that conforms to the atmosphere specifications in the draft standard for packaging plutonium oxide and metal. The standard requires an inert atmosphere with 100 ppm or less of water vapor. The Livermore boxes normally operate at 5 ppm. Unusual care was taken in the design and construction of the boxes to minimize in-leakage of room air. Another interesting point is that the argon is not recycled. There is a once-through system, that eliminates the problem of water vapor (or other undesirable things) gradually accumulating in the inert gas.

One of the argon boxes contains an unusual type of calciner that could apparently be used to stabilize plutonium oxide at the 1,000°C temperature required by the standard. The calciner is actually a molten salt furnace that holds a tall, thin crucible, that can hold 4-5 kg of plutonium oxide. When closed, the furnace is sealed off from the glove box atmosphere. Air is pulsed in and off-gases are pulsed out. The oxide is stirred by a mechanical stirring rod and fluffed up by the air pulses. Livermore personnel apparently get very good results with this method.

5. **Future Staff Actions:** The Staff will follow Livermore's implementation of Recommendation 94-1.