DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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August 3, 1995

The Honorable Thomas P. Grumbly
Assistant Secretary for Environmental Management
Department of Energy
Washington, DC 20585

Dear Mr. Grumbly:

Enclosed for your information and use is a report prepared by our staff on observations and issues concerning the B Plant and Waste Encapsulation and Storage Facility at the Hanford Site. The staff's review focused on the facility's capabilities to safely store the cesium and strontium capsules. The report identifies substandard operations and training and raises questions about the ability of facility personnel to identify and promptly address deficiencies that could compromise confinement.

Mr. David Lowe, of the Defense Nuclear Facilities Safety Board, will be available to provide any additional information you may require.

Sincerely,

John T. Conway
Chairman

c: The Honorable Tara O'Toole
Mr. Mark Whitaker
Ms. Jill Lytle
Mr. John Wagoner

Enclosure

95/3920

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

June 22, 1995

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: C. H. Keilers, Jr.

SUBJECT: Hanford - B Plant/Waste Encapsulation and Storage Facility Review

1. **Purpose:** This report documents a review by the Defense Nuclear Facilities Safety Board staff of the Hanford B Plant and Waste Encapsulation and Storage Facility (WESF). This review was performed on May 15-18, 1995, by P. Gubanc, C. Keilers, J. MacEvoy, R. Schapira of the Board's staff and D. Volgenau (outside expert).

2. **Summary:** This review focused on WESF capabilities to safely store the cesium and strontium capsules, since these capsules constitute about one-third of the Hanford radioactive inventory. The staff believes that WESF radioactivity is well confined compared to other Hanford facilities (i.e., double-encapsulated and stored in robust pools in the 200 Area). However, substandard operations and training raise questions about the ability of facility personnel to recognize and promptly address deficiencies that could compromise confinement. Also, the facility has not assigned a high priority to upgrading the WESF safety basis, and the current safety basis may have contributed to several recent occurrences.

3. **Background:** B Plant is a World War II era canyon facility that was converted to cesium and strontium extraction. WESF was built adjoining B Plant in the early 1970's and was used to fabricate 2217 capsules, each containing about 50 K Curies of strontium or cesium salt. About half of these were later shipped off-site for commercial use. In 1988, one leased capsule weeped radioactivity into a commercial pool. Because of the high cleanup cost from this small leak, all commercially leased capsules are being returned either to WESF or, if defective, to Pacific Northwest Laboratories (PNL). DOE has not yet determined the long-term disposition of the capsules.

4. **Discussion:** Department of Energy (DOE) and Westinghouse Hanford Company (WHC) briefed the staff on B Plant/WESF status, capsule and facility integrity, and the facility safety basis. The staff also observed operations, maintenance, and training. Generally, the staff found that both DOE and WHC management were aware of many of the facility's weaknesses. The DOE Facility Representative has been particularly effective in increasing this awareness. The staff considers that more facility emphasis is needed on upgrading the safety basis and on improving conduct of operations, maintenance, and training. Key staff observations follow and are discussed further in the attachment:

a. Although WESF radioactivity is relatively well confined, top-level management attention, not always evident in the past, will be needed to ensure that confinement is maintained until capsule disposition, which is probably at least twenty years away. Also, the B Plant HEPA filters, not removable by design, have accumulated a total radioactive inventory comparable to some individual Hanford waste tanks, and their disposition may involve significant engineering challenges that need to be identified.

b. The staff observed instances of poor conduct of operations, maintenance, and training. These observations raise questions on whether facility personnel would be able to recognize and promptly address deficiencies that could compromise confinement. The observations included, for example, ineffective supervision by supervisors and few substantive in-plant surveillances by managers and engineers. Also, the training program does not comply with the applicable DOE Order and standards.

c. Weaknesses in the existing safety basis may have contributed to recent WESF operational difficulties; however, completing the WESF Interim Safety Basis is not a high facility priority. For example, during two recent occurrences (WESF hot cell ventilation upsets), operator errors and problems in non-safety systems affected safety systems and operational safety requirements. In May 1995, the facility issued a corrective action plan that, although commendable, did not fully address the lack of a clear, comprehensive, and understood safety basis as a possible root cause. Expediting the Interim Safety Basis could assist the facility in avoiding operator errors and in identifying potential safety vulnerabilities due to non-safety systems.

d. The capsules generate considerable decay heat (about 0.5 MW total). The staff understands that, in the event of loss of all raw cooling water, several days would be available to respond before pools boil dry. However, neither definitive justification for accepting apparent vulnerabilities in the cooling system and ultimate heat sink nor definitive contingency procedures exist. Given the consequences of loss of shielding for nearly 100 M Curies, these would appear worthwhile.

e. DOE and WHC recognize that B Plant and WESF have vulnerabilities in structures, systems, and components that need to be quickly addressed. High facility priorities include accelerating B Plant hazard reduction, decoupling WESF systems from B Plant, improving capsule surveillance, and developing capability to identify a leaking capsule. Overall, the staff found the intended efforts reasonable--provided they are planned, funded, and executed. The staff will follow their implementation.

5. **Future Planned Activities:** The staff is separately evaluating long-term capsule integrity in WESF and will follow the facility's efforts to reduce vulnerabilities and correct operational and training deficiencies.

Many observed poor practices were, at least, inconsistent with site operational procedures. Issuing more written direction alone will not correct these deficiencies. The staff suggests that supervisors more actively and aggressively supervise; that all managers and cognizant engineers conduct meaningful in-plant surveillance and identify deficiencies; that identified deficiencies be tracked to resolution; and that management examine the trends in past occurrence reports and the findings in past reviews, drill critiques, etc., and determine and correct root causes.

Specific staff observations regarding these practices are as follows:

a. After maintenance was completed to balance a WESF safety system exhaust fan and to remove a limiting condition for operation, the DOE Facility Representative observed some missing and improperly installed fasteners in the fan discharge piping. He properly brought this to the attention of the system cognizant engineer.

   However, the facility did not take prompt action, and the actions that were taken were improper and reflected poor judgement. Consequently, a major planned evolution was delayed, work time was lost, and a previously uncontaminated area appears to have become contaminated. WHC management indicated that they would consider this event an occurrence.

b. Planned maintenance in B Plant to replace non-code fittings on a sensing line was observed. Examples of the deficiencies found are as follows:

   - The work package technical review, tag-out authorization, and radiological survey records were not completed prior to start of work. Also, the radiological control technician did not record the completion of the surveys on the Craft/Resource Usage Log and Maintenance Record (J-5 Form). These are both required by the WHC Work Management Manual (WHC-CM-1-8).

   - The assigned radiological control technician took many surveys, but he kept no records. He reconstructed the records about two hours later after being relieved. A radiological controls supervisor indicated this is standard practice.

   - Neither the assigned radiological controls technician nor his predecessor recorded the direct and smear contamination levels in their completed survey reports in the manner prescribed by the WHC Health Physics Procedures Manual (WHC-IP-0718).

c. The transfer and unloading of a capsule shipping cask was observed. Although the operation was completed without incident, success was due more to operator experience than adequate supervision or procedures. Example deficiencies include the following:

- The supervisor permitted the operators to perform various functions without active supervision or direct reference to approved procedures. Consequently, operators made many procedural deviations during the evolution.

- The supervisor delayed completing several data sheets required by procedure. However, the intent of the procedure was that data sheets be completed at the end of each pertinent step rather than sometime later. Some of the procedural steps involved operational safety requirements (OSR).

- The operation required the use of several procedures which were not consistent. For example, the requirements for signing off procedure startup prerequisites was not consistent among procedures, and some procedures required a data sheet sign-off for an OSR-related warning while others did not. The cognizant engineer present during the operation could not explain the inconsistencies.

d. A review of the facility self-assessment and surveillance programs indicated a need for improvement. Several assessments were conducted in a haphazard manner and contained few substantive comments. Also, positive actions resulting from completed evaluations were difficult to identify. There was no evidence of any recent assessments on the conduct of maintenance.

e. The B Plant Complex Self Assessment Implementation Plan, issued in April 1994, appears out of date, contains only operational and maintenance related activity assessments, and has not been fully implemented.

f. Some deficiencies reported during DOE-RL assessments in 1993 have not been corrected. DOE-RL has scheduled another operational assessment in June 1995.

g. The staff observed caution tag and labeling deficiencies and other material deficiencies of the type that should be detected by operator, supervisor, and management in-plant surveillances and then corrected. Examples from WESF include:

- Automatic damper controls for airflow between WESF cells and canyon do not operate on several cells. However, no caution tag was attached notifying operators that these dampers must be operated in manual mode. Also, the damper control switches were not labeled.

- WESF has two vacuum pumps, one in operation and one in automatic standby. One of these pumps will not automatically start from a standby mode and has been identified for an extended period as needing repair. A caution tag has not been attached to the pump control switches to notify the operators which pump should not be placed in standby.

- An apparently leaking valve is causing surface corrosion in a vertical line in the operating gallery next to G cell.

- Large patches of peeling paint exist in the chemical additions area (AMU).

- Evidence exists of wetting of an electrical cable under a labeled nitric acid pipe in the AMU overhead (no nitric acid is in the facility).

- Multiple layers of plastic sheet, some in poor condition, are taped over AMU ventilation duct louvers.

- Conflicting directives are posted outside some radiological buffer areas.

- Several valves in the facility chained and locked shut. The keys could not be located by facility personnel.

h. The staff reviewed recent occurrences and discussed occurrence reporting and evaluation with the facility. The staff considers that the facility does not have an effective system to properly evaluate occurrences, identify all root causes, and incorporate lessons learned, as evident from several recent occurrences and post-occurrence events. Examples of deficiencies identified in this year's occurrence reports but, based on staff observations, appear not fully addressed include:

- Inadequate supervision (95-3, 95-6, 95-12, 95-13, 95-19, 95-20)
- Inadequate lock-and-tag (95-6, 95-13, 95-15, see also 94-30)
- Loss of work control, leading to possibly hazardous conditions (95-6, 95-13)
- Ventilation or other difficulties due to steam system (95-2, 95-3, 95-18)
- Improper or missing radiation posting (95-5, 95-14)

Several similar deficiencies were also identified in last year's occurrence reports and in the 1993 DOE-RL assessment reports. An evaluation of the trends in occurrence reports, as well as previous internal and external assessments, could guide improvements in the facility.

i. B Plant/WESF is using an interim process to write and revise procedures. This interim process is expected to be fully developed and in place within the next few months. A final process will be implemented in the future. Although all of the existing procedures must be rewritten to comply with the new process, no evaluations of the effectiveness or correctness of existing procedures have been done in this interim period.

3. *Training and Qualification:* Training and qualification is vital to personnel being able to promptly identify and respond to deficiencies and vulnerabilities. However, the facility's

program in this area lacks sufficient formality, specificity, and substance to ensure quality training and qualification. Specific observations follow:

a. Although facility management anticipates full compliance with the current DOE training and qualification order[2] by October 1995, the facility does not yet comply with the previous version of the order and does not have approved detailed procedures in place to implement the training program.

b. In discussions with facility personnel, the staff observed many knowledge deficiencies. The level and number of these deficiencies raise questions on the adequacy of facility training. Some personnel with observed knowledge deficiencies include:

- Some cognizant engineers, on their systems (e.g., while discussing hook-up of emergency portable generators)
- Several radiological controls technicians, on radiological fundamentals and on the purpose of radiological surveys (while observing facility-specific training and surveys supporting operations and maintenance)
- At least one supervisor, on supplemental actions in emergency procedures (while discussing facility emergency procedures)
- Maintenance personnel, on work control procedures (while observing the replacement of non-code B Plant fittings). Maintenance personnel do not receive any formal training on work control procedures.
- At least one operator recording readings, on the purpose of the readings and the actions required for abnormal readings (while observing a qualified Nuclear Process Operator conducting a routine surveillance in WESF)
- A supervisor and nuclear process operator, on WESF ventilation systems (a safety system). Neither had any formal training on ventilation systems.
- Several operators and supervisors, on what conditions require radiation and continuous air monitors and on why it was acceptable for the facility to deactivate several of these units.

c. The training and qualification program for engineers, cognizant engineers, and engineering managers is self-study and has few measures of progress. There is no

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[2] DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities,* November 15, 1994.

qualification card or formal program for cognizant engineers and no requirement that they have detailed knowledge of systems that support their cognizant system.

d. Drills do not appear to be an integral part of the training program as regularly scheduled events. The two drill scenarios provided for review were basic and lacked sophistication. No completed drill critiques were provided.

e. The facility currently has no formal training on conducting assessments and surveillance. This contributes to the lack of an effective WHC self-assessment and surveillance program.

f. A review of the Training Implementation Matrix, approved by DOE-RL in April 1995, revealed that it lacks sufficient specificity to ensure a quality training and qualification program. Further, the document indicates that the facility is in compliance with all requirements which can not be the case based on what was seen during this review.

4. *Safety Basis:* Weaknesses in the existing safety basis and its implementation may have contributed to the WESF hot cell ventilation upsets on March 20 and again on April 15,1995. During these occurrences, operator errors and problems in non-safety systems occurred that affected safety systems and operational safety requirements.

- In the first event, a pipe fitter inadvertently isolated the instrument air system (a non-safety system), which in turn shut down the hot cell ventilation (a safety system). Consequently, hot cell pressure increased, leading to contamination in the operating gallery and canyon. The radiological controls organization was initially unaware of the possible consequences.

- In the second event, an operator secured steam heating (a non-safety system), which in turn lead to an automatic temperature switch shutting down the operating galley ventilation. Operating galley pressure decreased, initiating an alarm (the first indication of a problem). An operator then, effectively, opened the operating gallery to the outside to maintain differential pressure between the operating gallery and the hot cells (an operational safety requirement). Discussion with facility management indicate that crossing ventilation systems by opening the operating galley door is undesirable.

In May 1995, the facility issued a corrective action plan that included reviewing the ventilation systems and OSR compliance, modifying OSRs based on updated accident analyses, and providing OSR refresher training. Although proactive and useful, this plan only addressed ventilation aspects and did not fully address the lack of an up-to-date WESF safety basis as a possible root cause.

5. *B Plant HEPA Filters:* The B Plant HEPA filters are underground, not removable by design, and have accumulated a total radioactive inventory comparable to some individual Hanford waste tanks (750 K Curies). Although the B Plant accelerated hazard reduction program would isolate the HEPA filters, their ultimate disposition is undetermined. Given their age and possibly degraded condition, safe disposition may involve significant engineering challenges which need to be identified.

6. *WESF Pool Water Chemistry:* WESF has water chemistry specifications (i.e., activity, conductivity, chloride) and an unshielded, non-regenerative ion exchanger system that is switched among the pools. Based on facility discussions, it has been an extended period since resin was changed, and no specifications exist on when to change resin. Considering the consequences of long-term capsule and pool liner corrosion, more definitive and justifiable water chemistry controls appear necessary.

7. *Other WESF vulnerabilities:* It was not apparent during the review what engineering trade-off studies had been done to determine that encapsulation capability should be developed at PNL instead of WESF and that installing package steam boilers instead of eliminating steam dependence of safety systems is the best course. Given the cost and safety implications involved, objective trade-off studies appear worthwhile.

Attachment
Board Staff Review of Hanford B Plant and
Waste Encapsulation and Storage Facility

I. **Introduction:** On May 15-18, 1995, members of the Defense Nuclear Facilities Safety Board staff and an outside expert performed an on-site review of Hanford B Plant and the Waste Encapsulation and Storage Facility (WESF). B Plant was reviewed only to the extent required to understand its interfaces with WESF. This attachment describes the facilities and the capsules and then provides the staff comments.

II. **Facility Description:**

B Plant was built at the end of World War II and was used between 1967 and 1984 to extract cesium and strontium from tank wastes. The facility has three operating galleries and forty canyon cells, twenty-nine of which are now deactivated. B Plant and WESF are under the same management and share some important systems, such as the central control room, waste transfer systems, and the raw water cooling system.

B Plant hazards include high activity in underground non-removable HEPA filters (750 K Ci) and a large contaminated solvent inventory in some cells (9 K gal, 35 K Ci). The facility has initiated an accelerated hazard reduction program. DOE plans to decouple B Plant from WESF by 2000 and to transition B Plant to the Surplus Facilities Program by 2002.

WESF was constructed in 1974 and was used until 1985 to process feed from B Plant and double-encapsulate cesium and strontium salts. Capsules are still stored in WESF pools in unanchored racks. The facility has an operating gallery, seven hot cells with remote manipulators, a canyon on top of the hot cells, eleven pools for storing capsules (about 9500 gallons each), and a truck port for receiving the capsule shipping cask. The pools are isolated from each other and have stainless steel liners.

WESF's main hazard is nineteen-hundred radioactive capsules in the pools (90 M Curies total). High pool area radiation levels are expected if a capsule leaks (one entire cesium capsule, 500 Rem/hr). WESF has several vulnerabilities related to the capsules, including uncertainty on inner capsule integrity, inability to quickly identify which capsule among hundreds in a pool is leaking, inability to re-encapsulate or repair a capsule, and inability to clean up a contaminated pool other than by feed and bleed to tank farms. DOE plans to disposition the capsules by 2011 and transition WESF to the Surplus Facilities Program by 2013.

III. Capsule Description and History:

Between 1975 and 1985, WESF fabricated 2217 capsules. About three-quarters of the capsules contain cesium chloride, while the remainder contain strontium fluoride. Each capsule contains about 50 K Curies, weighs about 50 lbs, and consists of an inner capsule free to move within the outer capsule (i.e., double-encapsulation).

After fabrication, about half the cesium capsules were shipped off-site and leased to commercial irradiation facilities. In 1988, one of these leased capsules leaked less than 10 Curies into a commercial pool (0.02 percent of the capsule's content). Reports indicate that an inner capsule weld ruptured due to thermally-induced plastic ratcheting, and the outer capsule weeped radioactivity through interstitial stringers. The thermal-ratcheting was driven by cycling the capsule temperature through a cesium chloride phase transition at 800 F to 900 F. Although the outer capsule was plastically deformed, no through-thickness defects were found. Facility clean-up costs were about $ 50 M. Eleven other capsules were discovered to be deformed in the same manner, but intact. No similar failure mechanism has been identified for the strontium capsules.

Because of this event, DOE is recovering all leased capsules. All but twenty-five will be returned by June 1995. The rest are expected back in FY 96. Some other capsules were shipped to government laboratories (ORNL, PNL) and foreign countries, and have been destroyed or transferred to other programs and will not be returned (about three hundred).

IV. Staff Comments:

1. *Capsule Integrity:* Some cesium capsules have experienced extreme thermal cycling, and some are now twenty years old. Furthermore, the older capsules were fabricated and initially inspected before several process improvements were made. Also, it is not yet apparent that strontium capsule failure modes, such as inner capsule corrosion, are fully understood. Capsule integrity probably needs to be assured for at least another twenty years. The staff is evaluating long-term capsule integrity in WESF.

2. *Operations and Maintenance:* The staff observed several instances of poor conduct of operations, poor work control practices, and poor radiological controls. These raise questions about the facility's ability to identify and promptly correct deficiencies, as well as conduct non-repetitive operations. DOE-RL also has concerns in this area,[1] and has scheduled a comprehensive operational assessment of the facility in June 1995, which will include operations, maintenance, radiological controls, and training and qualification.

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[1] DOE-RL Letter 95-WOD-039 from Director, Waste Operations Division, to President, Westinghouse Hanford Company, "Control of Operations at the B Plant/Waste Encapsulation Storage Facility (WESF) Complex," May 19, 1995.