DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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October 21, 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 24 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 (24)

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

March 10, 1993

MEMORANDUM FOR: G. W. Cunningham, Technical Director

FROM: Richard E. Tontodonato

COPIES: Board Members

SUBJECT: Trip Report - Review of Hanford Site High Level Waste Tank Safety Issues, February 9, 1993

1. **Purpose:** This memorandum summarizes a review of selected high level waste (HLW) tank safety issues conducted by the Defense Nuclear Facilities Safety Board (DNFSB) Technical Staff during the February 8 -12, 1993 Board trip to Hanford.

2. **Summary:** Topics discussed were high double shell tank (DST) annulus airborne radiation levels, potentially flammable gases in the vapor space of tank 241-C-103, actions to address potentially toxic vapor emissions from numerous tanks, and the overall HLW tank sampling plan.

   a. **DST annulus radiation:** WHC is actively pursuing the source of high DST annulus radiation readings found in two DSTs, 102-AZ and 107-AN. WHC did not offer a theory to explain the sporadic nature of the high readings, or why the high readings seem to be associated with one particular batch of waste, when other DSTs containing similar waste have not exhibited problems.

   b. **Flammable gases in tank 103-C:** Vapor samples taken in 1990 using an unvalidated cryogenic method indicated tank 103-C contained an unsafe concentration of flammable gases (74% of the lower flammability limit). WHC is now developing validated methods for sampling gases inside the HLW tanks and expects to sample 103-C by June 1993 using a validated technique to determine whether an unsafe concentration of flammable gases exists.

   c. **Toxic vapor emissions:** Due to repeated worker exposures to vapor emissions, workers in the single shell tank farms currently must use supplied air or, in some lower risk farms, must be accompanied by air monitoring technicians. WHC is sampling vapors both inside and outside the tanks to determine where harmful or irritating vapors are present. DOE-RL has set a goal of June 1993 for deciding whether less drastic corrective actions are acceptable.

d. **HLW tank sampling plan:** Hanford has developed a master tank sampling schedule accommodating the different programs which need information on the tanks' contents. The near-term emphasis is on sampling ferrocyanide tanks and other watchlist tanks. The document showing how the schedule was developed is not yet available for review. Laboratory characterization continues to be slow, but improvements are in progress.

3. **Background:** The Hanford Site has 177 carbon steel tanks used for storage of high level radioactive liquid wastes. The 149 single shell tanks (SSTs) were built between 1943 and 1964 and range in size between 55,000 and one million gallons, with a total capacity of approximately 100 million gallons. The 28 double shell tanks (DSTs) were built between 1968 and 1986, and each has a capacity of about one million gallons.

   Sixty-seven of the SSTs are known or assumed to have leaked. Forty-eight of the SSTs and five of the DSTs are on a watch list defined by Public Law 101-510, Section 3137. The watch list tanks have the potential for release of radioactive wastes to the environment through explosions, fires or structural failure. Key to resolving most of these safety issues is characterizing the wastes in the tanks, a process which is going slowly.

   DNFSB Recommendations 90-3 and 90-7 addressed the need to more rapidly characterize and monitor the 24 tanks containing potentially explosive ferrocyanide wastes and also the need for emergency planning to respond to a tank accident. The DNFSB Technical Staff reviews progress on resolving these recommendations and the numerous other waste tank safety issues on a continuing basis. Members of the DNFSB Technical Staff performing this review included Richard E. Tontodonato, Steven A. Stokes, Sol Pearlstein and an Outside Expert, John Straub.

4. **Discussion:** The DNFSB technical staff met with WHC and DOE-RL representatives on February 9, 1993 to review issues relevant to HLW tank safety. Information learned in the course of these discussions is summarized below:

   a. **High DST annulus airborne radioactivity levels.** Sporadic annulus continuous air monitor (CAM) readings above the action level specified in WHC's DST leak detection procedure have been observed for tanks 102-AZ and 107-AN. The high readings occur as peaks above the normal level followed by a return to normal levels in a relatively short time. (The CAMs are read daily, and high readings usually return to normal levels by the next time the CAMs are read.)

      o 102-AZ first received waste in the late 1970's and first showed higher than expected CAM readings in November 1983, with the highest peak at 9000 cpm on February 21, 1984. Current CAM readings for 102-AZ are not available because its annulus exhaust system and CAMs have been out of service for about a year.

The 102-AZ CAM was indicating normal radiation levels when it went out of service.

- 107-AN was first, and last, used in 1983 to receive complexant concentrate waste from 102-AZ. 107-AN started showing high annulus CAM readings on February 21, 1985, with the highest peak at 14,000 cpm on January 14-15, 1993. Small CAM peaks in other AN farm tanks have accompanied large 107-AN peaks.

  107-AN is also a concern because its caustic concentration is below WHC operating specifications. Action to correct this condition is needed to avoid reducing the tank service life due to accelerated general corrosion of its carbon steel walls.

The WHC criteria for declaring a DST leak require finding both elevated radiation levels and long lived isotopes in the annulus. Analysis of the 107-AN CAM filters in September 1984 and July 1992 showed radon daughter products but no long lived isotopes. Video inspection of the 107-AN annulus (30% coverage) and sump found no evidence of leaks in 1986 and May 1992, and wet and dry swipes of the annulus taken in 1985 exhibited no contamination. Accordingly, Hanford does not consider these tanks confirmed leakers, and attributes 60,200 gallons of liquid lost from 107-AN between October 1983 and December 1992 to evaporation. However, older DSTs at the Savannah River Site (SRS) have leaked without emitting detectable long lived isotopes, so WHC is not ruling out the possibility of leaks.

After reviewing the ventilation system design, WHC has concluded that cross connections between the primary and annulus ventilation system are not the source of the high CAM readings. Current efforts are directed at determining whether the radon daughters found by the CAMs are from terrestrial sources infiltrating the secondary containment or from leaks in the primary tank. CAMs are being installed at several locations in the AN farm (e.g., 107-AN annulus inlet, 107-AN pump pit) to try to locate the source. Also, after the next peak with enough activity to make daughter product analysis feasible, the radon daughters in the CAM filters will be analyzed to see if the daughter chains are characteristic of tank waste or natural radon sources. Also, WHC is consulting WSRC for insight on DST leaks. WHC plans to address the AZ tank farm high annulus CAM issue once they have a working theory for the AN farm.

In conclusion, WHC is actively pursuing the DST CAM alarm issue. They do not have a theory to explain the sporadic nature of the high readings or why the high readings seem to be associated with the same waste that was in both 102-AZ and 107-AN. (WHC stated that other DSTs containing similar waste have not exhibited problems.)

b. **Flammable vapors in tank 103-C.** Samples taken in 1990 from the tank 103-C vapor space using a cryogenic sampling method detected flammable vapor concentrations of 74% of the lower flammability limit (LFL). WHC specifies 20% of the LFL as the highest allowable concentration, and the industry standard is 25%. However, the specific cryogenic method used in the 1990 sampling was not validated and is now considered inaccurate by WHC and an outside reviewer (Northwest Instrument Systems, Inc.). A recent WHC calculation estimated that the organic vapor/aerosol mix in tank 103-C does not exceed 18% of the LFL, based on the temperature and chemistry of the waste and estimates of aerosol properties. WHC is developing validated methods to sample the 103-C vapor space and expects to have a definitive sample by June 1993.

c. **Potentially toxic vapor emissions.** Because of numerous exposures of workers to harmful or unknown vapors in the tank farms, WHC and DOE-RL took the conservative step of requiring supplied air for workers in six single shell tank (SST) farms until this issue is resolved. The six tank farms of particular concern contain ferrocyanide tanks, which may produce HCN, and odor producing tanks, including 103-C. As discussed in paragraph (b) above, WHC is developing a validated in-tank vapor sampling method that will be used to define what vapors are being generated by the wastes. In addition to in-tank sampling, WHC plans to characterize gases near the tanks using area monitors and personnel gas monitors (air samplers attached to workers). WHC is working toward a goal set by DOE-RL to have the information needed to determine whether less drastic corrective actions will protect workers in these tank farms by June 1993.

   In the other SST farms, for which no specific concerns were identified, continuous coverage by air sampling technicians is allowed as an alternative to supplied air. WHC stated the information available from air monitoring in these farms to date supports ending the monitoring/supplied air requirement. If the personnel monitoring program also indicates no vapor hazards, WHC plans to end the monitoring/supplied air requirements for these tank farms, possibly as soon as March 31, 1993.

d. **HLW tank sampling plan.** Most of the HLW tank safety issues cannot be resolved until the contents of the tanks are known. WHC has developed a "Master Core Sampling Schedule" (WHC-SD-WM-TI-532, Rev. 0, October 6, 1992) accommodating the different programs that need information on the tanks' contents. The near-term emphasis is on sampling ferrocyanide tanks and other watchlist tanks (e.g., 107-AN, 103-C, and the tank with the highest heat load, 106-C). More emphasis on tanks with high organic content or tanks producing flammable gases may be warranted; however, the documentation showing how the schedule was developed is not yet available for review. The most recent schedule for core sampling through September 1993 is attached.

One factor affecting the schedule is the current inability to sample tanks with a hard crust on the wastes. Sampling these tanks requires drilling through the crust (rotary mode sampling), and the heat of friction could initiate chemical reactions in some wastes. Because of this hazard, WHC has suspended rotary mode sampling until it is shown safe. Tanks without crust are being sampled by pushing a sampling tube through the soft wastes (push mode sampling). WHC expects to complete a Safety Assessment (SA) to allow rotary sampling by September 1993, and has arranged the schedule accordingly. The schedule also accounts for the fact that rotary mode sampling is more time-consuming than push mode sampling.

Few tanks will have more than two cores sampled from them. Since the wastes cannot be assumed to be homogeneous, more samples may be needed to adequately resolve some safety issues, such as criticality, ferrocyanide and organic/nitrate reactions. WHC stated that the rebaselining effort for the Hanford Tank Waste Remediation System (TWRS), expected to be done by March 31, 1993, will address how many cores are needed per tank.

WHC stated that sampling capacity is currently the limiting factor in characterizing the tanks' contents, but this is largely due to the fact that sampling was suspended for about three months because of problems with procedure compliance. WHC plans to operate multiple shifts in the hot cell and sample preparation labs, and to persuade PNL to do the same, to expedite characterization during FY93 and FY94. WHC is purchasing a second core sampling truck to deploy in September 1993, which will definitely make laboratory characterization the limiting factor in FY94 and FY95. The following activities are underway to increase laboratory capacity and productivity, which should make laboratory characterization no longer limiting after FY95:

o Hot cell clean out in PNL 325 laboratory - Old equipment is being removed from four hot cells so they can be used for tank waste characterization. One cell is done, and the entire effort should be completed by December 1994.

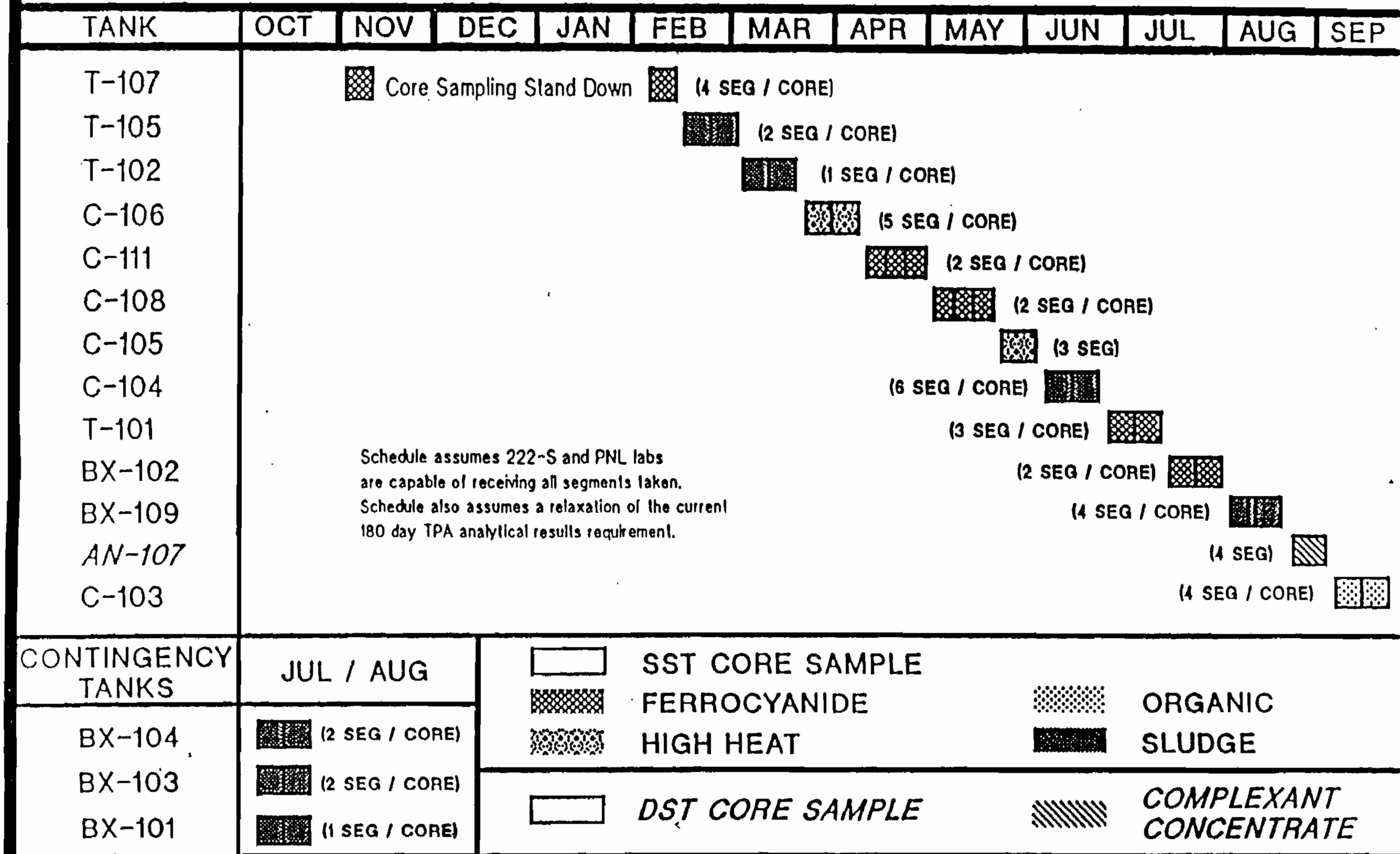
o Laboratory information system - A computer-based data acquisition and reporting system is being obtained to save the time and effort currently spent manually copying large volumes of data from test equipment. WHC expects the system to arrive in June 1993 and estimates that about a year will be required for full implementation.

- Hot cell addition to Hanford 222-S laboratory - Ten additional hot cells will be added to the 222-S laboratory by June 1994. Currently only three cells are available for waste characterization, and one of those mostly supports the grout and evaporator facilities.

WHC plans to procure additional sampling trucks in 1995 and 1996 to more fully use the increased laboratory capacity these improvements will provide.

FY 93 INTEGRATED CORE SAMPLING SCHEDULE

FEBRUARY 1, 1993



TANK WASTE CHARACTERIZATION PROGRAM - REV 4