DEFENSE NUCLEAR FACILITIES SAFETY BOARD

May 12, 1994

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: Steven Stokes

SUBJECT: Waste Management at the K-East Basin

1. **Purpose:** This memorandum documents a trip to the K-East Basin at the Hanford site on March 15-17, 1994, a video-conference on April 5, 1994, and a tele-conference with K-East Basin staff on May 2, 1994, to review the waste management program. The technical staff participants were Steven Stokes, J. Kent Fortenberry, Timothy Dwyer, and Dominic Napolitano.

2. **Summary:** Current waste management practices at the K-East Basin can not fully support the planned fuel encapsulation activities because encapsulation is scheduled to be initiated prior to waste certification of the K-East Basin transuranic waste streams. Currently, neither of the two K-East Basin transuranic (TRU) waste streams (spent cartridge filters and ion exchange columns) can be dispositioned and must be stored at the K-Basins.

   The most significant issue is associated with the storage of spent ion exchange columns in a chlorine vault at the K-West Basin. An analysis of the potential for build-up of hydrogen gas in the ion exchange columns has been completed, recently revealing that in four of the 39 spent ion exchange columns, the calculated hydrogen concentrations in the columns are in excess of the lower flammability limit. The technical staff considers this a significant safety issue that should be addressed immediately.

   Additionally, compliance with DOE Order 5820.2A, *Radioactive Waste Management*, has not been adequately assessed. A preliminary review by the Board's staff revealed noncompliance with requirements for inspection and contingency plans for temporary TRU storage. This noncompliance is particularly significant given the long-term storage required for both uncertified TRU waste streams and the potential for releases.

3. **Background:** The K-East and K-West Basins are used for the storage of spent nuclear fuel (SNF) from the N-Reactor. Spent nuclear fuel in the K-East Basin is currently stored in open-topped aluminum and stainless steel canisters. Prior to the planned encapsulation of this fuel, a review of the waste management program was conducted by DNFSB staff to assess readiness to support fuel encapsulation operations.

4. Discussion/Observations:

a. Organization. The K-Basins Waste Management (WM) program is the responsibility of the Westinghouse Hanford Company (WHC) facility manager. Most of this responsibility has been delegated to the K-Basins WM Program Manager. Additional support, e.g., packaging and transportation, safety analysis reports, and disposal operations, is provided on an as needed basis by other WHC organizations. Oversight is provided by the Department of Energy-Richland Operations Office (DOE-RL) Waste Management organization.

b. Waste Streams. Two types of waste are generated at the K-Basins; low level waste (LLW) and TRU in five waste streams. There are three LLW streams generated. These are: (1) compactable (disposable anti-contamination garb, paper, rags, etc.); (2) non-compactable (inoperable machinery, pipes, etc.); and (3) spent ion exchange modules. Two TRU waste streams are generated. These are: (1) spent ion exchange columns; and (2) spent cartridge filters. At present, neither of the TRU waste streams is certified for disposal. These wastes must be stored at the K-Basin facility until a suitable disposal certification is obtained. Plans are to have the spent cartridge filters certified for disposal by December of 1994.

Currently, no plan or schedule exists for the disposition of the spent ion exchange columns. The disposition process is quite complicated and requires involvement by the packaging and transportation group, safety analysis group, central waste management, and the waste generator (K-Basin facility management). A plan and schedule integrating all activities would facilitate a much more organized resolution of this condition. (This dysfunctional condition has existed for over three years.)

The spent ion exchange columns are currently located in the chlorine vault located in K-West. There are 39 spent ion exchange columns. Each column is cylindrical in shape and contains 5.5 ft^3 of purolite NRW-37 mixed anion-cation resin. Prior to disposal, each column was fitted with a small granulated activated carbon filter to allow for continuous venting of the column. The ion exchange columns are stored in two concrete "drag-off" boxes (8x21x10 feet); 33 spent ion exchange columns are contained in one box and six are in the other. Each ion exchange column was placed in the drag-off box on its side in a random fashion; therefore, the relative position of the carbon filter is not known (this is important if standing water could accumulate and block the filter).

Each drag-off box is open-topped with two concrete cover blocks placed over each box. The joint between the cover blocks and the drag-off box is fitted with a rubber seal; however, the joint between the two cover blocks is not sealed (estimates for the distance across this gap range from 0.003 to .063 inches). The drag-off box is not filtered. The potential for build-up of gases within the drag-off box is a function of the generation rate of gases from within the columns and the rate at which gases are released from the box. WHC personnel experienced with hydrogen generation (101-SY) have modeled the

expected generation rates of hydrogen for each ion exchange column, given its radionuclide loading and expected release rate from the drag-off box. They determined that: (1) Hydrogen gas is generated from the columns; and (2) if atmospheric breathing and diffusion are considered as mechanisms for hydrogen escape, hydrogen concentrations within the airspace of the drag-off box will build up to a calculated level of 0.8% hydrogen (this assumes a gap of 0.003 inches between the two cover blocks). If the gap between cover blocks is assumed to be 0.063 inches, the calculated result is a 0.4% hydrogen concentration. The lower flammability limit (LFL) for hydrogen in air is 4.0%.

Additional modeling concerning the build-up of hydrogen within the ion exchange columns has recently been completed. Based on the source terms identified for each spent ion exchange column and no plugging of the granulated carbon filter; four of the ion exchange columns currently in storage have calculated concentrations above the lower flammability limit for hydrogen in air (calculated level is ~5% hydrogen); twenty-nine of the ion exchange columns have calculated hydrogen concentrations of 1%; and the remaining six have negligible hydrogen concentrations. The technical staff considers this a significant safety issue that needs to be addressed immediately.

Potential for hydrogen buildup in the chlorine vault is currently considered negligible by WHC because of the unsealed, floor-to-ceiling vault doors, and initial testing of the atmosphere within the vault, with a combustible gas meter, resulted in no detection of combustible gas mixtures. This initial finding supports WHC's assumptions. Additionally, the testing revealed no combustible levels of gases issuing from the drag-off boxes, i.e., the gap between cover blocks. The instrument used to conduct these tests, however, is not specific for hydrogen. This limits the conclusions that can be drawn concerning the presence of hydrogen within the vault and the drag-off box. Additional testing is necessary to fully characterize the fate of hydrogen generated from the ion exchange columns.

An unreviewed safety question has been declared, *Occurrence Report RL-WHC–KBASINS-1994-0008, Irradiated Fissile Material, May 5, 1994,* to assess the unbounded dose consequences for a potential ignition and release of radioactive material from the spent ion exchange columns. However, no action plan exists for eliminating the build-up of hydrogen within the columns known to have concentration higher than the lower flammability limit. Administrative controls have been placed on entry to the chlorine vault (currently no entry is allowed without specific permission from the plant manager) and on movement of the drag-off boxes. WHC personnel stated that the next steps in the handling of this issue are: (1) the development of an action plan to address the now known generation of hydrogen from the ion exchange columns, (2) resolution of the USQ, and (3) additional investigations to further determine the potential for build-up of hydrogen in ion exchange columns/modules (both at the K-Basins and in Waste Management Facilities).

c. Compliance with DOE Order 5820.2A, *Radioactive Waste Management.* Compliance with this order is assessed annually by the WHC Central Waste Management organization. The standard used for this review is WHC-EP-063 (revision 4), *Waste Acceptance Criteria*, which explicitly references DOE Order 5820.2A. WHC-E-0063 also incorporates requirements from other DOE Orders as well as regulatory requirements (i.e., Resource Conservation and Recovery Act requirements). However, as a result of discussions with DOE-RL and K-Basins waste management personnel, it was evident that key DOE Order 5820.2A requirements, contingency plans and inspection procedures for temporary TRU waste storage do not exist.

Additionally, as a part of the preparations for encapsulation, a DOE-RL Order Compliance Self-Assessment Pilot Program was initiated. DOE Order 5820.2A was not considered applicable under this program. WHC's rationale for this was that since wastes were to be dealt with **after** encapsulation, a waste management compliance assessment was unnecessary. DOE-RL has agreed to review this position prior to encapsulation.

d. Waste management preparations for encapsulation. Numerous activities must be completed by K-Basins Waste Management prior to initiation of encapsulation activities. Foremost among these is certification of the TRU waste streams. In addition to the spent ion exchange columns, the cartridge filter wastes also require continued storage in the 100-K Area. Currently, 13 spent filter cartridges are stored in the 100-K Area: six are stored in the K-East Basin water and seven are stored in grouted culverts behind the K-East Basin.

In preparation for encapsulation operations, waste generation forecasts were made. Current forecasts are for the generation of 12 spent ion exchange modules per year (these will be managed as LLW; this determination is controlled by careful monitoring of breakthrough concentrations of cesium-137, which can be tied to the final TRU content). Spent cartridge filters are also expected to be generated at the rate of 12 per year. These will be managed as TRU wastes (the cartridges become TRU wastes after only hours of operation; therefore, management as TRU is the only option). There are no forecasts for ion exchange columns, since there is no intention to operate this system. Note that the K-Basins air permit requires operation of either the ion exchange modules or ion exchange columns during encapsulation activities. With the ion exchange columns not operating, any event that forces an ion exchange module out of service will force the suspension of encapsulation activities.

5. **Future Staff Actions:** The staff will pursue the following: (1) evaluate the actions necessary to resolve hydrogen build-up concerns associated with the storage of spent ion exchange columns; (2) review the adequacy of waste certification plans to support K-Basin operations; and, (3) assess the ability of K-Basin Waste Management to support the encapsulation of spent nuclear fuel in the K-East Basin. Additionally, the staff will evaluate the potential safety issues associated with the past practice of disposing of spent ion exchange columns and modules in the 200 area burial grounds.