DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700 Washington, D.C. 20004-2901
(202) 694-7000

January 17, 2006

The Honorable James A. Rispoli
Assistant Secretary for Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Mr. Rispoli:

The Department of Energy (DOE) has been planning to retrieve samples of the highly radioactive soil near underground waste Tank W-1A at the Oak Ridge National Laboratory to support planning for eventual soil disposal. Excavation of the soils near Tank W-1A had been attempted by the contractor, Bechtel Jacobs Company, in 2001 but was suspended due to the discovery of higher-than-expected radiological contamination.

In early November 2005, the Defense Nuclear Facilities Safety Board (Board) conducted a review of preparations for sampling the soil surrounding Tank W-1A. This review was followed by several discussions among the Board, DOE, and their contractor. The enclosed report provides observations resulting from this review and is provided for your use. The Board observed weaknesses in the application of Integrated Safety Management for this activity, especially in the core functions of identification and analysis of hazards, and identification and implementation of controls for worker protection. Based upon discussions held during December 2005, the Board understands that following the review, Bechtel Jacobs Company acknowledged that significant additional work was necessary, and postponed soil characterization startup while taking steps to address the issues.

Pursuant to 42 U.S.C.§2286b(d), the Board requests a briefing on the steps being taken to address the observations in the enclosure and ensure worker protection before Tank W-1A soil characterization activities are initiated.

Sincerely,

A. J. Eggenberger
Chairman

c: Mr. Gerald G. Boyd
Mr. Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

December 21, 2005

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: R. Raabe

SUBJECT: Review of Work Planning for Tank W-1A Soil Characterization and Sampling at Oak Ridge National Laboratory

This report documents a review of work planning for the Tank W-1A soil characterization and sampling project to be carried out at Oak Ridge National Laboratory (ORNL). The review was conducted from October 31, 2005 to November 1, 2005, by members of the staff of the Defense Nuclear Facilities Safety Board (Board), F. Bamdad, D. Burnfield, D. Owen, R. Raabe, and D. Winters, along with outside expert D. Volgenau. Subsequent discussions, including a telephone conference among the Board's staff, the Department of Energy (DOE), and their contractor during December 2005, identified activities planned to correct many of the deficiencies noted in the report.

Background. Tank W-1A collected wastes from analytical facilities with high radiation levels at ORNL, including Building 2026, Building 3019B, and Radiochemical Processing Pilot Plant Building 3019. Tank W-1A was installed in 1951 and removed from service in 1986. During its operation, the transfer line to Tank W-1A from Buildings 2026 and 3019 is suspected to have leaked, causing soil and groundwater contamination around the tank. In 2001, a remediation project was attempted to remove Tank W-1A and the contaminated soils. After removal of about three-quarters of the contaminated soils, an area with higher-than-expected radiological contamination was found. On-contact dose rates ranged from 400 mrem/hr to 6 rem/hr. The remediation was suspended, the excavation was backfilled, and the facility was subsequently declared an inactive waste site. The remediation project is now being renewed; it will begin with sampling and characterization, followed by removal of the remaining contaminated soil (about 100 yd^3) and Tank W-1A.

The project, being conducted by Bechtel Jacobs Company (BJC), is currently focused on sampling and characterization of the soil around Tank W-1A. Key objectives of these activities are to perform radiological characterization of the soil and to develop a three-dimensional map showing the locations of soil meeting the definition of transuranic and low-level waste. Sampling will be accomplished by retrieving cores of the contaminated soil using a direct-push drill rig and dual-wall soil sampling system. The soil cores will be analyzed with gamma spectroscopy and then cut to obtain samples for more definitive, off-site analyses. At the time of the staff's review, DOE and BJC personnel indicated that the management self-assessment was planned for the week of October 31, 2005, the BJC readiness assessment for the week of

November 7, 2005, and the startup of the project for the week of November 14, 2005. This activity is to be controlled to be below Hazard Category 3 thresholds for nuclear material.

Observations. The Board's staff made numerous observations during its review and on-site discussion of work planning for the soil sampling and characterization project associated with Tank W-1A. The staff found that the state of the project preparations and work planning was such that protection of workers could not be ensured. Several core functions of Integrated Safety Management were not being followed effectively in planning the work.

BJC had not planned adequately and was not prepared to carry out all the necessary activities associated with the project. Despite the stated intention to conduct the BJC readiness assessment during the week of November 7, 2005, mockup training and dry runs of the various tasks had not been completed, and the contractor was not prepared for an integrated demonstration of the full sampling activity to support a line management declaration of readiness. Such an integrated dry run is especially important given the potential radiation levels, the potential for airborne radioactivity, the complexity of the tasks involved, the multiple subcontractors, and the multiple interfaces at the site.

Identify and Analyze the Hazards and Implement Controls—The process used to identify and analyze the hazards associated with the planned work was not adequate to ensure that appropriate controls would be in place to protect workers. The prepared work instructions required significant improvement to enable safe and successful accomplishment of the sampling and characterization:

- The work instructions called for cutting the soil cores for further radiological characterization or for size reduction prior to waste packaging. Some of the core samples were to be cut on a table under a canopy. After the staff expressed concern about conducting such activity in the open air, the contractor committed to performing all cutting and resizing of soil cores in a glovebox.

- The activity hazard analyses were generic in nature. They did not accurately identify the significant hazards associated with the work, nor did they comply with the requirements of the contractor's directive, BJC-EH-2010, *Hazard Assessment*. For example, neither hazards nor controls associated with a high radiation area were identified. Also, hazards associated with individual work steps were not evaluated.

- The work instructions were complicated, lacked specificity, and were not worker-friendly. The roles and responsibilities of all participating entities were not well defined, the way in which independent activities were to be supervised and coordinated was not clearly spelled out, and many actions required that workers refer to other documents to learn how they were to be accomplished.

- The activity hazard analyses did not formally examine potential undesirable events or what-if scenarios (e.g., drop/damage to the high-efficiency particulate air vacuum

cleaner or the core samples during delivery) for associated hazards and the identification of appropriate controls. The staff emphasized the role of a proper hazard analysis in the development of controls to prevent scenarios or ensure they are adequately mitigated.

- Material and procedural problems were observed during a field demonstration of the drilling equipment to be used for obtaining soil samples. Drill rig operators and radiological controls personnel participated in the demonstration to illustrate their actions during sampling evolutions. It was evident from the demonstration that the procedures to be used for the sampling and characterization project required further improvement to ensure a smooth and safe process. In addition, several mechanical problems that developed with the drilling rig and its hardware during the demonstration could have exposed workers to hazards unnecessarily.

- The project instituted a materials inventory control program intended to keep the quantity of radionuclides brought to the surface below the threshold for Hazard Category 3 per DOE-STD-1027, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*. The inventory control program uses measured levels of cesium-137 and ratios based on previous sampling to estimate the quantity of other radionuclides present in the soil. However, there did not appear to be any provision in place to confirm or update the ratios in the corresponding calculations with the results from more detailed off-site analyses.

- The pre-job as low as reasonably achievable (ALARA) review discounted the significance of high radiation readings observed during previous excavation work with Tank W-1A because of the reduced volume of soil being brought up to the surface. In so doing, it failed to account for the potential for hot spots. The Board's staff believes the analysis needs to assume material that reads at least 10 rem/hr on contact, especially since readings of 6 rem/hr have been recorded during previous work.

- There is the potential of an abnormal event in which a soil core with a dose rate exceeding 1 rem/hr cannot be returned to its original position in the sampling hole. These soil cores could have measurable dose rates as high as 6 to 10 rem/hr. It was not clear that the project planning accounted for the possibility of this type of occurrence or that this possibility had been analyzed in the design of the shielding. Furthermore, it was not clear that the thresholds for Hazard Category 3 would not be exceeded if the calculation had used ratios corresponding to a core sample representative of the dose rate actually detected during the earlier work (6 rem/hr).

- Despite knowledge that the sampling and characterization work could be a high-radiation activity with the potential for airborne radioactivity, a radiation safety plan (RSP) was not prepared during the work planning effort. The contractor's directive,

BJC-EH-4000, *Radiation Protection Program,* calls for preparation of an RSP if necessary to address project-specific radiation protection practices when planning for radiological work.

- The radiation work permits are being used to establish controls for the project, and are referred to for controls in the activity hazard assessment. This is an improper approach to hazard analysis. Radiation work permits are not supposed to establish controls, but they should implement the applicable controls identified in the activity hazard assessment.

- The radiation work permits do not require workers to wear multiple whole-body dosimetry. Further, it was not apparent that consideration had been given to the use of foot dosimetry. Depending upon the position of workers during transport of the soil core, it would be quite possible for a nonuniform radiation field to exist. Article 512 of DOE-STD-1098, *Radiological Control*, defines a nonuniform radiation field as occurring "when the dose to a portion of the whole body will exceed the dose to the primary dosimeter by more than 50 percent and the anticipated whole body dose is greater than 100 mrem." Article 512 recommends that multiple dosimeters be issued in nonuniform radiation fields. The correct use of mockup and worker positioning studies would provide the information needed to determine whether multiple whole-body and/or foot dosimetry is required.

- The calculations used in the pre-job ALARA review to determine transferable contamination thresholds for requiring respiratory protection appear problematic. The calculation for alpha contamination was based on plutonium-239; however, the Board's staff considers that it would be appropriate to base the calculation on thorium-229, since it has a more limiting derived air concentration value and has been present in Tank W-1A soil at concentrations close to those for plutonium-239. Additionally, the equations and calculations appear to be in error.

- The radiation work permits allow respirators to be donned in either a contamination area zone or a high-contamination area zone. This practice could lead to potential internal exposures to workers.

- The contractor plans to use a shield device and transport tool to shield and transport the soil cores. The shielding device consists of a stainless steel carrier that is approximately 0.25 inch thick. It will be used for moving soil cores that have a measurable dose rate of at least 5 mrem/hr. The technical basis for the shielding device was unclear, as were its specifications, such as the tolerance and type of stainless steel to be used. Also, it was unclear why the shielding device would not be used for all cores having any measurable dose. The transport tool for carrying soil cores to ensure that extremities are a distance of at least 30 cm from the soil cores had not yet been designed or demonstrated for the scheduled management self-assessment. Although the transport tool was mentioned in the pre-job ALARA

review, the stated intention to maintain 30 cm to extremities was not clearly incorporated in that review.

- While the contractor planned to label individual cores with sampling location information, there was no plan to include radiation levels. Clear labeling of the radiation levels on each core would be useful to aid workers in minimizing doses consistent with ALARA, in handling/transport of the cores.

- There was no provision for informing radiological control technicians of the expected dose for a particular sample location to allow for efficient presetting of dose ranges on the Teletector probe. The Teletector probe is used to monitor the radiation levels of soil cores as they are being raised. It comprises low-range and high-range Geiger-Mueller detectors. Thus, if an improper dose range were used (e.g., one of the three ranges for the low-range detector used to measure a high-radiation field), the low-range detector could become saturated, resulting in an incorrect reading of 0 rem/hr.

- The contractor stated that cutting of cores prior to waste packaging is necessary to fit pieces into 5- or 10-gallon waste drums currently planned for use. The contractor could not explain the basis for limiting packaging to these smaller drums or for not evaluating the use of larger waste drums to minimize the need for size reduction of cores. In addition, there were no apparent plans to shield the drums while they are being stored in the staging area before transport.

- DOE and contractor personnel were not aware of an August 2005 memorandum from the DOE Assistant Secretary for Environment, Safety and Health that establishes guidance for setting limiting conditions for radiological work. They indicated that they would review the guidance and use it as appropriate.

Provide Feedback and Continuous Improvement—Previous work has been conducted and technical reports written regarding Tank W-1A; however, it was not apparent that the contractor had drawn upon this information to improve the process for the current project. For example, the applicable details of an August 2004 Technical Assistance Team report had not been considered in the work planning for this project. The purpose of that report was to identify and evaluate alternative solutions for remediation of the contaminated soils adjacent to Tank W-1A. Project personnel were not familiar with the details of this report and did not know whether consideration of its conclusions had been part of the work planning efforts. The report was not included on the reference list in the work planning documentation.