DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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June 25, 2008

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

Dear Mr. Rispoli:

The staff of the Defense Nuclear Facilities Safety Board (Board) visited the Savannah River Site on March 31–April 3, 2008, to review the reliability and availability of selected vital safety systems in the high-level waste tank farm facilities. The Board's staff also reviewed the implementation of specific administrative controls, the contractor's system engineer program, and the safety system oversight (SSO) program of the Department of Energy-Savannah River Operations Office (DOE-SR). Based on its review of the selected VSSs, the Board's staff found the safety systems to be adequate to perform their safety functions in the near term. However, the Board's staff found weaknesses in the oversight programs for VSSs, raising questions about the future reliability of those systems. These weaknesses are detailed below:

- The DOE-SR staff includes only one qualified SSO engineer for all tank farm facilities. Overall, the program is suffering as a result of vacancies and high turnover. The situation has worsened since the Board last reported on this program in 2006.

- The qualification process for contractor system engineers at the tank farm facilities fails to provide the detailed, system-specific training required by DOE Order 420.1B, *Facility Safety.*

- System performance monitoring at the F-Area tank farm has been drastically reduced and is no longer in compliance with DOE Order 420.1B or Order 433.1A, *Maintenance Management Program for DOE Nuclear Facilities.*

The enclosed report further includes observations regarding conductivity probes and specific administrative controls. The Board's staff is concerned that certain components in the conductivity probe system may not function properly in some upset conditions. The Board's staff also identified the need for more specificity in Specific Administrative Controls to improve their implementation.

Although DOE-SR and the contractor have taken initial steps to address the deficiencies identified during the Board's visit, significant work will be required to ensure the reliable operation of safety systems in tank farm facilities. The Board notes that site managers have taken several actions to more fully comply with DOE Order 420.1B, including:

- DOE-SR approved elevating the paygrade of several SSO engineers and filling SSO vacancies as a top priority.

- The contractor issued a System Performance Monitoring Plan that defines the system performance monitoring requirements for F-Area tank farm systems that are needed for long-term operation.

- The contractor instituted a qualification process that defines the system-specific training requirements for new, existing, and reassigned system engineers. This process includes a walkdown and oral assessment to demonstrate the engineer's knowledge of the assigned system.

- The contractor formed a Liquid Waste Operations Facilities Equipment Viability Evaluation Team to address life extension issues.

- The contractor has increased senior management oversight of vital safety systems that are experiencing performance issues.

Implementation of these initial steps to resolve the identified deficiencies will be monitored by the Board.

Pursuant to 42 U.S.C. §2286b(d), the Board requests that appropriate representatives of DOE and contractor management brief the Board within 90 days of receipt of this letter on the corrective actions taken to address these issues.

Sincerely,

A. J. Eggenberger
Chairman

c: Mr. Jeffrey M. Allison
Mr. Mark B. Whitaker, Jr.
Mr. Robert J. McMorland

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

May 19, 2008

MEMORANDUM FOR: T. J. Dwyer, Technical Director

COPIES: Board Members

FROM: M. Sautman and L. Zull

SUBJECT: Vital Safety Systems at High-Level Waste Tank Farms, Savannah River Site

This report documents issues related to the reliability and availability of selected vital safety systems (VSSs) in the high-level waste (HLW) tank farms at the Savannah River Site (SRS), as well as to the contractor's system engineer program and the Department of Energy's (DOE) safety oversight program. These issues were identified during a review conducted by L. Zull, H. Massie, and D. Ogg of the staff of the Defense Nuclear Facilities Safety Board (Board), together with Site Representatives M. Sautman and M. Duncan. The initial review was conducted during March 31–April 3, 2008; and was followed by additional meetings conducted by the Board's Site Representatives.

Background. The staff reviewed four selected VSSs: the waste transfer system (waste transfer lines, valves, jumpers, etc.), conductivity probes, the ventilation system for diversion boxes, and the HLW tank cooling water systems. These systems were selected because they provide important safety functions for the prevention and mitigation of severe accidents.

HLW is initially transferred from one tank to another using a transfer pump located in the sending tank. The waste travels through transfer lines, generally connected to diversion boxes, before reaching its destination (e.g., another HLW tank). There are more than 300 waste transfer lines in the F- and H-Area tank farms. The most common type of transfer line has a stainless steel core pipe (3-inch diameter, typically) encased within a carbon steel secondary pipe. A diversion box allows the waste to be routed through the proper section of transfer line to reach its destination. The chromate cooling water system provides cooling water to the HLW tanks.

The staff conducted detailed reviews of the selected VSSs, including related system performance monitoring reports, the Documented Safety Analysis (DSA), and the Technical Safety Requirements (TSRs). The staff also performed a detailed review of a procedure for the transfer of waste from Tank 40 to Tank 51 and conducted a walkdown of the waste transfer path. The staff reviewed the functional requirements for each system as documented in the DSA, and noted that the requirements are clearly specified. The staff reviewed structural integrity reports for the selected systems, which are key to maintaining equipment functionality. The structural

integrity program determines potential degradation mechanisms and the required frequency of inspections, requirements for nondestructive evaluation, and additional maintenance needs for accessible portions of a system to help prevent gross failures. The staff also reviewed the contractor's system engineer program and DOE's safety system oversight program.

Based on its review of the selected VSSs, the staff found the safety systems to be adequate to perform their safety functions in the near term. However the staff raised several questions regarding the reliability of the conductivity probe system in certain upset conditions. Additionally, the staff found weaknesses in the oversight programs for VSSs, raising questions about the future reliability of those systems. The staff's observations are described in detail below.

Authorization Basis. The authorization basis for the HLW tank farms includes the DSA, TSRs, DOE's Safety Evaluation Reports (SERs), and other documents listed in the Authorization Agreement. The contractor issued a new DSA and TSRs in December 2002 to satisfy the requirements of Title 10 Code of Federal Regulations (CFR) Part 830, Subpart B, *Nuclear Safety Management,* and has issued other updates since.

The safety controls consist of structures, engineered systems, and administrative controls. Chapter 4 of the DSA identifies the safety-class (SC) and safety-significant (SS) controls relied upon to prevent or mitigate the accidents analyzed in Chapter 3. At the SRS HLW tank farms, heavy reliance is placed on administrative controls to protect the public and site workers from the consequences of postulated accidents. DOE Standard 1186-2004, *Specific Administrative Controls*, contains guidance on the use of specific administrative controls (SACs) relied upon to perform safety functions.

The staff reviewed the DSA and TSRs for the HLW tank farms to assess the compliance with Standard-1186. The standard lists a number of characteristics that an SAC should include, such as redundancy, independence, diversity, validation, and human reliability assessments.

The contractor has revised several company-wide manuals, including the TSR Methodology Manual, to incorporate the guidance of Standard-1186. Generally, the flowdown of requirements from Standard-1186 to the DSA, TSRs, and procedures appears adequate, and SACs are appropriately highlighted in these documents. As a noteworthy practice, the staff found that the contractor had performed a human reliability assessment for SAC related to installing portable ventilation for pump tanks prior to certain waste transfers.

The staff found that the SACs at the HLW tank farms generally meet the characteristics of redundancy, independence, and diversity. However, one area for improvement is the specificity of SACs. In a number of cases, the SACs are vague and could be implemented improperly. As an example, the SAC for the Event Response Program includes an action step that reads, "Verify HDB-8 PVV [process vessel ventilation] system suction damper position in response to a loss of offsite power." The action statement does not specify in what position the damper is to be verified. In other cases, SACs call for certain components to be isolated, but do not specify how or within what time period.

Conductivity Probes. Conductivity probes are installed in several locations (including waste tanks, waste tank annuli, evaporator and condenser cell sumps, valve boxes, diversion boxes, pump pits, and leak detection boxes) to detect the presence of liquid. The tip of the probe is set at or below the maximum permissible height of the waste. When the probe comes in contact with liquid, an electrical circuit is completed that actuates a visual and audible alarm in a control room, a local field alarm, and/or an associated interlock.

Conductivity probes are relied upon to perform an SC function during some accidents, but do not meet all of the requirements for an SC system. Instead, compensatory measures are relied upon. The staff plans to obtain more information on the other components of the system (e.g., relays, alarms, indicators) to assess the adequacy of these compensatory measures.

System Performance Monitoring. DOE Order 420.1B, *Facility Safety,* requires a qualified cognizant system engineer for each SC and SS system at DOE nuclear facilities. The HLW tank farms include several of these types of systems.

The staff reviewed the selected VSSs in the HLW tank farms and identified issues related to the training of system engineers, system design descriptions (SDDs), system performance monitoring, lack of a life extension program, and lack of adequate staffing of the DOE safety oversight program for the HLW tank farms. These issues are discussed in detail below.

Training of System Engineers—DOE Order 420.1B specifies the requirements for system engineers. The order contains training and qualification requirements that include the system functional classification, applicable codes and standards, system design and condition, and vendor information. These requirements are captured in the SRS site procedure on design authority training. The Board's staff reviewed the system engineer qualification cards and training records, and interviewed selected system engineers. All tank farm engineers receive the same overview training on the tank farm systems, but there is no established process to ensure they receive the detailed, system-specific training and qualification required by DOE Order 420.1B.

The qualification of system engineers in the HLW tank farms consists of engineering managers developing a list of system assignments and documenting them in a memorandum. There are no system-specific qualification cards for system engineers, nor do their training records include any documentation that they have been trained and qualified for their assigned systems. System engineers do not receive formal training on the codes and standards applicable to their assigned systems or the systems' detailed design. The staff's interviews with engineers and their managers indicated that any system training is almost entirely self-directed by the engineers. Training has also been negatively impacted by high turnover among engineering management and sudden reassignments of system engineers. The result can be a system engineer who receives little background information on the system, whose management provides no expectations for the training needed, and whose manager does not review his training progress with him.

While it may not be practical to develop training courses on every system, the staff believes it is feasible to develop a system-specific qualification card. Such a card would require an engineer to know the relevant authorization basis requirements; to understand the codes and standards applicable to his system; and to become familiar with other system information, such as vendor manuals and product warnings. In addition, managers could take a more proactive approach to verifying the engineers' level of knowledge by reviewing their training progress and performing system walkdowns with them.

System Design Descriptions—A complicating factor in the training of system engineers is the lack of current SDDs. SDDs were developed for tank farm systems, but ceased being maintained in the mid-1990s, although some engineers still reference them. SDDs can consolidate much of the information that would be required by a system qualification. Although it may take time and money to update the SDDs, an interim solution would be to define expectations for the type of information that system engineers should maintain in their system files. The development of SDDs and more methodical system files would facilitate turnovers to new engineers and prevent the loss of system knowledge when senior system engineers retire or change assignments, especially with short notice.

System Performance Monitoring—DOE Order 420.1B states that system performance monitoring is an integral part of a system engineer's responsibilities. Performance monitoring includes periodic review of a system's operability, reliability, and material condition. Furthermore, these reviews must assess the system for its ability to perform design and safety functions, its physical configuration compared with system documentation, and its performance compared with established performance criteria. In a May 2, 2003, letter to the Board, DOE's Assistant Secretary for Environmental Management stated that DOE would ensure that VSS assessments are institutionalized by the contractor in a DOE-approved assessment schedule. The contractor's system engineers are to use approved procedures and Criteria and Review Approach Documents to perform VSS assessments.

DOE Order 420.1B provides no guidance on how results of these reviews should be documented. Washington Savannah River Company (WSRC) has a site procedure, *SSC* [structures, systems, and components] *Performance Monitoring* (E7 Manual, Procedure 3.04), which states that the results of such reviews should be documented in what is called a System Heath Report (SHR). A recommended format for these reports is provided, but this format is very general. The main requirement is that all SC and SS SSCs be monitored at a level commensurate with their importance to safety. The rest of the procedure includes a recommended format for documenting system health, guidelines for identifying SSC monitoring needs, and good practices for SSC performance monitoring—none of which are requirements. Several facilities at SRS perform comprehensive system health reviews, typically on an annual basis. While this was done at the tank farms a few years ago, the practice was discontinued.

In May 2007, the F-Area tank farm became a closure project, and all system health reviews ceased, except for the evaporator. Even though some of the VSSs are required to support tank closure activities or have longer missions, the staff was told that this shift reflected the change from an operating to a closure project model. During interviews, the staff was also

told that while cognizant engineers used to be responsible for performing system trending and preparing SHRs, they were now plant engineers focused on day-to-day performance and no longer did this trending. The system engineers at the F-Area tank farm do not perform VSS assessments in accordance with approved procedures. Engineering management acknowledged that their own self-assessments had identified a need for increased monitoring of selected systems.

Instead of annual SHRs, the H-Area tank farms began issuing monthly System Performance Monitoring Reports (SPMRs). The information recorded and tracked in the SPMR depends on the assigned system engineer and the specifics of the system. The engineer determines the parameters to track, evaluates system performance, and identifies suggested repairs or replacements. All systems also receive an overall grade of green, yellow, or red.

The staff's review of SPMRs yielded the following observations. There is no procedure for the expected format or content of these reports, and the staff found little consistency among them. While the staff appreciates that the type of monitoring can vary considerably among systems, the staff believes the process would benefit from the establishment of procedural guidance on what core topics, at a minimum, should be addressed in each report. The SPMRs also do not contain all of the information that was included in the SHRs, such as information on reliability, availability, and maintainability analysis; spare parts needed; safety basis changes; predictive and preventative needs; system failure analysis; and planned modifications. While the staff believes that the SPMRs are useful, the SHRs contained important historical information and offered longer-term trending information on equipment performance. Furthermore, the SPMRs could do a better job of highlighting what parts of the system are not performing as desired and what actions are recommended by the system engineer. One of the goals of these reports is to serve as a tool for highlighting to facility management those issues requiring action.

Life Extension Program—As with H-Canyon, an integrated approach is needed for the HLW tank farms to ensure that the infrastructure required to maintain their health and safety exists. A life extension program entails more than the current performance monitoring program. It is a systematic and integrated program for determining the need for maintenance program changes, additional inspections, and equipment upgrades or replacement to extend the operating life of safety and nonsafety systems. The staff found that while the narrower-scope SPMRs addressed performance monitoring data, they often did not address longer-term issues. For example, DOE Order 433.1A, *Maintenance Management Program for DOE Nuclear Facilities,* requires periodic inspections of SSCs and equipment to determine whether degradation or technical obsolescence threatens performance or safety. Considering that the tank farm mission will continue for two decades, it would be beneficial to evaluate periodically the ability of safety and nonsafety systems to support the mission. After the staff's visit, WSRC formed the Liquid Waste Operations Facilities Equipment Viability Evaluation Team. The purpose of this team is to ensure that tank farm facilities and systems are capable of operating as required to support the mission of the tank farms. The team's focus will include both safety and nonsafety systems that are necessary for life extension.

DOE Safety System Oversight—DOE's Assistant Manager for the Waste Disposition Project employs engineers that perform safety system oversight (SSO) in the HLW tank farms. The SSO engineers' roles and responsibilities are documented in DOE Manual 426.1-1A, *Federal Technical Capability Manual,* and in Attachment A of DOE-Savannah River Operations Office (DOE-SR) Manual SRM 226.1-1A, *Performance Assurance Manual.* DOE-SR created a new position, called a Facility Engineer, that consolidated SSO, safety basis review, and technical design assessment functions. Facility Engineers are augmented by subject matter experts in the structural, electrical, criticality, and fire protection areas. They are required to perform reviews of VSSs, including obtaining objective evidence that the VSSs are performing their design functions adequately, and assessing trends and evaluating the adequacy of the qualification and oversight of contractor-assigned system engineers. Facility Engineers coordinate with Facility Representatives to ensure the readiness and operability of VSSs.

However, attrition has impacted Facility Engineer staffing. Only three of nine Facility Engineers are qualified. Currently, only one qualified Facility Engineer is assigned to the tank farms; two others are in the qualification process, and four positions are vacant. This deficiency in Facility Engineer staffing causes a shortfall in day-to-day oversight of work, and could delay the approval of changes to the safety basis.

DOE recognizes this staffing deficiency. Management has documented plans for increasing the grade level of qualified Facility Representatives and plans to take other actions until the program is fully staffed. Management has also approved elevating the paygrade of several Facility Engineers and the hiring of additional engineers. Given the current lack of staffing, however, DOE's safety oversight of contractor activities in the HLW tank farms may be less than adequate.