DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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February 6, 2009

The Honorable Thomas P. D'Agostino
Administrator
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0701

Dear Mr. D'Agostino:

The staff of the Defense Nuclear Facilities Safety Board (Board) has been monitoring the development of the replacement Radioactive Liquid Waste Treatment Facility at Los Alamos National Laboratory. The Board's staff has reviewed (1) the enhanced preliminary design, (2) safety basis, and (3) actions described in the National Nuclear Security Administration's letter of May 6, 2008, and the briefing provided to the Board on June 26, 2008. The Board believes that fundamental problems remain with federal oversight of the project and integration of safety into the design of the facility. A substantial number of outstanding design issues require resolution before final design activities are initiated—several of these items were identified in December 2007 and still remain unresolved. Unless these issues are promptly addressed, schedule pressure driven by the need to support the site's critical mission requirements may adversely impact design decisions that affect the overall safety, cost, and utility of the facility.

The enclosed report details the above issues and is provided for your information and use as appropriate. The Board will continue to review the development of the design of this facility.

Sincerely,

A. J. Eggenberger
Chairman

Enclosure

c: The Honorable William C. Ostendorff
Mr. Thad T. Konopnicki
Mr. Donald L. Winchell, Jr.
Mr. Mark B. Whitaker, Jr.

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

December 15, 2008

MEMORANDUM FOR: T. J. Dwyer, Technical Director

COPIES: Board Members

FROM: D. Eyler

SUBJECT: Replacement Radioactive Liquid Waste Treatment Facility Project

This report documents a review by the staff of the Defense Nuclear Facilities Safety Board (Board) of the replacement Radioactive Liquid Waste Treatment Facility (RLWTF-R) project at Los Alamos National Laboratory (LANL). Staff members D. Eyler, J. Plaue, R. Kasdorf, J. Pasko, B. Broderick, and T. Davis were on site the week of November 3, 2008, to review the project's organization and management controls; implementation of the commitments made by the National Nuclear Security Administration (NNSA) in response to the Board's letter of March 5, 2008; and the results of the Enhanced Preliminary Design (EPD) effort. Two Board Members, J. Bader and L. Brown, participated in the concluding brief of site and project personnel.

Background. The Board's letter of March 5, 2008, sent to NNSA following a review of the preliminary design of the RLWTF-R project, cited issues related to federal oversight and integration of safety into the design. In a letter dated May 6, 2008, and a briefing given on June 26, 2008, NNSA committed to accomplishing a number of actions to address these issues.

In April 2008, NNSA authorized the initiation of the EPD effort for the RLWTF-R project. The purpose of the EPD was to update preliminary design documents, implement actions in response to the Board's letter, address shortcomings in the draft Preliminary Documented Safety Analysis (PDSA), and accomplish some additional design work. Initiation of the final design was held in abeyance until the Record of Decision for the LANL Site Wide Environmental Impact Statement was issued and questions were resolved about the technical viability of using tanks in the Cerro Grande Rehabilitation Waste Management Risk Mitigation (WMRM) project for routine storage of influent low-level radioactive liquid waste.

The EPD package was completed at the end of July 2008. Subsequently, the Record of Decision for the LANL Site Wide Environmental Impact Statement was approved. However, questions about the use of the WMRM tanks for storage of influent low-level radioactive liquid waste had not been resolved by the end of September 2008. The Los Alamos Site Office (LASO) issued a memorandum dated September 30, 2008, requiring the LANL contractor, Los

Alamos National Security, LLC (LANS), to address several issues prior to initiation of the final design of the RLWTF-R project. The contractor was required to (1) submit a safety design strategy for the project, (2) complete a confinement ventilation system evaluation in accordance with *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*, (3) provide a recommendation for the material to be used for process tanks and piping, (4) complete an updated PDSA addressing prior comments, and (5) propose a viable option for the storage of influent low-level radioactive liquid waste. Additionally, the LASO memorandum required LANS to propose formal review "hold points" during the final design to ensure integration of the design and PDSA development.

Project personnel intend to request Critical Decisions 2 and 3 concurrently, and have developed a plan for conducting reviews consistent with Department of Energy (DOE) Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets*, and DOE Standard 1189-2008, *Integration of Safety into the Design Process*, during the final design.

Federal Oversight. While the Board's staff noted some improvement in senior management oversight and application of resources to the federal Integrated Project Team (IPT) during the review, the oversight lacks the formality expected, and resources have not been committed to the IPT as described in both the NNSA letter and the brief to the Board provided in response to the Board's letter of March 5, 2008. Furthermore, the IPT did not accomplish an effective review of the EPD package.

Management Oversight—LASO senior management has been involved in overseeing the RLWTF-R project. LASO assigned a senior Federal Project Director from another project to provide periodic oversight and mentoring of the project team, including the federal IPT, an action that appears to have been beneficial. LASO has revised its procedures and practices to require greater involvement of the federal IPT members during the design process. LASO holds monthly Project Watch List meetings that are intended to address issues with projects that fail to meet performance expectations; the RLWTF-R project is included on the Project Watch List. According to the LASO procedure that governs the Project Watch List, representatives of projects on the list are expected to make a formal presentation of issues and the plan for their resolution at the meeting; the Project Watch List Board reviews, comments on and concurs with the plan for resolving the issues; and actions identified as a result of the meeting are to be formally documented and tracked. In practice, the meeting focuses on the status of the project and outstanding issues; the identification and documentation of actions to resolve issues lacks formality, reducing the effectiveness of this management tool in addressing weaknesses in project management.

Federal IPT Resources—LASO has funded two positions for personnel who will provide technical support to the RLWTF-R federal IPT (as well as to other projects). These positions have not been filled. LASO has not assigned the additional Federal Project Director support detailed in the NNSA letter and brief to the Board provided in response to the Board's March 5, 2008, letter. These personnel were to assist in oversight of integration of safety into the design, development of the quality assurance program, and oversight of the Zero Liquid Discharge

subproject (assistance with this final item has not been necessary since this subproject has been on hold). One additional issue identified during the staff's review was the lack of a chemical engineer on the federal IPT. Considering that the RLWTF-R project relies primarily on chemical processes to perform its functions, such expertise would be invaluable to the team.

Review of the EPD Package—The plan for the federal IPT's review of the EPD package focused on ensuring that the design incorporated requirements established in the safety basis and evaluating the impact of applying DOE Standard 1189 to the design effort. This plan fell short in defining the depth of review to be accomplished. Additionally, the federal IPT's review of the EPD package was not finished at the time of the staff's review, and the path to completion of this task was unclear. Furthermore, the nature of the discrepancies noted by the staff within EPD documents discussed elsewhere in this report indicates that the portions of the review completed by the federal IPT were ineffective in ensuring the full incorporation of safety-related requirements into the design.

Safety Basis Development. The methods used to develop the safety basis for the project have been revised, although the rigor of and commitment to these methods are questionable. The confinement strategy for a fire in the treatment building is not clear in the draft PDSA. The document is internally contradictory in its description of what structures, systems, and components (SSCs) are relied upon for confinement of radioactive material and hazardous chemicals during a fire.

Hazard Analysis Technique—The hazard and operability analysis (HAZOP) technique was adopted for the project's hazard analysis of systems posing substantial radiological and chemical hazards, which the staff considers appropriate. However, according to the draft documentation of the HAZOP results, the analysis team's membership was limited primarily to two safety analysts whose knowledge of RLWTF-R is based on a review of project documentation. The lack of integration of personnel with specific knowledge of the RLWTF-R engineering design and operation of the existing facility into the HAZOP study limited its effectiveness in identifying hazards and operational problems with the design.

Determination of Collocated Worker Dose—According to the NNSA letter sent in response to the Board's March 5, 2008, letter, collocated worker dose is to be calculated using the methodology described in DOE Standard 1189 to ensure appropriate selection of safety-related controls. The draft PDSA developed during the EPD effort did provide calculations of collocated worker dose. However, it stated that these calculations were for information purposes only, and may be included in the safety analysis at later stages of the project should the analysis be required to follow DOE Standard 1189. The calculations did not fully incorporate the dose conversion factors contained in International Commission on Radiological Protection Publications 68 and 72 as specified by DOE Standard 1189 and a memorandum directed to site office managers from the NNSA Central Technical Authority dated February 22, 2008. Project personnel stated their intention was to determine collocated worker dose as described in DOE Standard 1189.

Confinement Strategy in the Event of a Fire—DOE Order 420.1B, *Facility Safety*, requires that Hazard Category 2 facilities confine uncontained radioactive materials during and following accidents. The means for meeting this requirement for RLWTF-R during a fire is unclear as outlined below.

The process system tanks and piping are described in the draft PDSA as being the primary confinement barrier; however, the confinement function of these SSCs during a fire is not included in the hazard evaluation table. The document also describes the potential susceptibility of tanks and piping made of reinforced thermoset plastic (RTP) to failure during a fire should this material be used. In the safety-related controls table provided as part of the hazard analysis, these SSCs are designated as having the safety-significant function of providing "full or partial" confinement in the event of a fire. Elsewhere in the document, however, the safety-significant confinement function of these SSCs is limited to normal and abnormal operations and to periods during and following seismic events.

The fire suppression system is designated in the draft PDSA as safety-significant because of its safety function of preventing a fire from dispersing radioactive material and spilling hazardous chemicals. Elsewhere in the document, the system's safety-significant designation is stated to be based on the need to control fire growth, thereby reducing the likelihood that a fire will cause a release of radioactive or hazardous material in the building. The draft PDSA does not explicitly require the fire suppression system to prevent failure of the primary confinement barrier.

The draft PDSA is inconsistent regarding what safety-related controls are provided by the building confinement system (defined by the draft PDSA as the treatment building structure and confinement ventilation system) during a fire. The draft PDSA describes building confinement as providing "confinement defense in depth" during an internal fire, and states that it is not designated as safety-significant because of the accident's small radiological consequences, the presence of a safety-significant fire suppression system, and the ineffectiveness of the confinement ventilation system in mitigating the release of hazardous chemicals. The document further states that, since the building's ability to remain standing and continue to act as a confinement structure during anticipated fire conditions is not a safety-significant function, the structure's roof is not required to meet the requirement of DOE Standard 1066-1999, *Fire Protection Design Criteria*, to provide a 2-hour fire barrier. In the safety-related controls table, however, the structure is designated as safety-significant, credited with preventing structural failure due to an internal fire (as well as other accidents). This description is repeated elsewhere in the document.

Design Process. The implementation of databases to track safety assumptions and design requirements has improved the management of the safety basis and design configuration. However, the staff noted some discrepancies. For example, the draft PDSA produced during the preliminary design (dated August 2007) designated the portion of the transuranic waste treatment system between the neutralization tank and sludge drumming tank and the entire hydrochloric acid system as safety-significant. However, portions of these systems were not designated as

safety-significant in the system design descriptions produced during the EPD effort. The same draft PDSA designated the fire suppression system as Performance Category (PC)-2, while the specification contained in the EPD package designated the system as PC-3.

Additionally, requirements specified in the draft PDSA developed during the EPD effort were not integrated into associated design documents. For example, the updated PDSA significantly changed the safety-significant boundary in the transuranic waste treatment system because of the potential for transuranic wastewater to bypass the microfilters. However, the piping and instrumentation diagram and system design description contained in the EPD package do not reflect the revised boundary.

Outstanding Design Issues. As discussed previously, two significant design issues require resolution: storage of influent low-level radioactive liquid waste and selection of material for process tanks and piping. During the staff's review, several additional outstanding design issues were also discussed.

Use of WMRM Tanks—LANL has proposed using the WMRM tanks to receive and store influent low-level radioactive liquid waste instead of designing a separate capability to meet this need. LANL has also proposed that the WMRM project be designated a radiological facility (instead of Hazard Category 2), and intends to modify the project's design to facilitate administrative controls to protect that designation. This limitation will need to be factored into any use of these tanks for storage of low-level radioactive liquid waste. To address the concern that the storage tanks installed in the WMRM project are made of a combustible form of RTP, LANL is seeking a technical interpretation from NNSA of the requirement in DOE Standard 1066 that combustible materials should not be used in the construction of process system confinement barriers. Additionally, LANL identified compensatory actions in light of the material's combustibility. With respect to potential degradation of the RTP material as a result of radiation exposure, LANL has taken the position that the WMRM tanks will not be affected by exposure from low-level radioactive liquid waste based on a review of available literature, operating experience, and proposed testing of the effects of radiation on the material properties of RTP.

The technical justification provided by LANL regarding the combustibility of RTP and its potential susceptibility to degradation as a result of radiation exposure is insufficient to conclude that the use of the WMRM tanks for storage of low-level radioactive waste is acceptable. The justification for the use of combustible material for the WMRM tanks is based upon coating the tanks with intumescent material, designing the fire protection systems to compensate for the tank's combustibility, and instituting an administrative control of combustible loading in the building. However, no specific fire hazard analysis was performed to evaluate how well these actions protect the tanks in the event of a fire inside or outside of the building. The review of available literature and operating experience regarding the effects of radiation on the material properties of RTP did not provide information directly applicable to the material used or to the operating conditions of the WMRM tanks. Consequently, testing was proposed by the personnel doing the study to gain better understanding of how RTP material

properties change in the anticipated environment. However, the specific test plan has not yet been developed, precluding assessment of its adequacy.

Material Selection—During the staff's review, LANL representatives stated that plastic-lined stainless steel is to be used as the material for process tanks and piping in the RLWTF-R project, but that the use of RTP was still under consideration. There are RTP materials that have limited combustibility. Project personnel intend to use the study and testing to be done for the WMRM tanks regarding the effects of radiation on RTP material to justify its use in the RLWTF-R project. LANL representatives also stated that their intention was to demonstrate the equivalency of the design standards for RTP to those specified in DOE Guide 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for Use with DOE O 420.1, Facility Safety*.

Criticality Safety—Criticality safety in RLWTF-R will be based on engineered and administrative controls employed upstream of the facility by the waste generators. LANL's Nuclear Criticality Safety Group has recommended the installation of tanks with favorable geometry, either in RLWTF-R or upstream in Technical Area 50, as a defense-in-depth feature. Whether or not to install these tanks has not been decided; additionally, the location of such tanks if installed has not been determined.

Pressure of Natural Gas Supply—According to the hazard analysis in the draft PDSA, the pressure of the natural gas supply to the central utility building must be limited to prevent the accumulation of natural gas from a leak to a concentration above the lower flammability limit at the treatment building's ventilation intake. However, the pressure-regulating valve that accomplishes this function has not been designated as a safety-related SSC.

Ongoing Evaluations—Project personnel have elected to use the approach detailed in DOE Standard 1189 to specify the seismic design basis for safety-related SSCs. Seismic Design Category 2 has been selected; determination of the Limit States is ongoing. Additionally, evaluation of the confinement ventilation system in accordance with *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems* is in progress.

Development and Use of Lessons Learned. Lessons learned from experience with the RLWTF-R project have not been developed as discussed in the NNSA letter sent in response to the Board's letter of March 5, 2008. LASO has maintained that the lessons learned from this project are captured in DOE's April 2008 root-cause analysis report regarding impediments to contract and project management. However, the RLWTF-R Federal Project Director received the associated corrective action plan (issued in July 2008) only recently, and therefore has not determined which of these actions should be considered for applicability to the project. LANS did develop a specific lesson learned pertaining to the selection of RTP as the material for process tanks and piping during preliminary design without adequate consideration of design guidance.

The report regarding the NNSA Office of Infrastructure and Facilities Management (NA-50) reviews of compliance of LANL projects with DOE Order 413.3A (discussed during the NNSA brief to the Board provided in response to the Board's letter) has not yet been made available to the RLWTF-R project, precluding corrective action for any applicable issues.

The updates of site safety and design procedures outlined in the NNSA letter and brief to the Board provided in response to the Board's letter have not been completed; this effort is expected to be completed in 2009. Development of design and safety basis review plans, which was discussed in the NNSA letter sent in response to the Board's letter, is in progress.

Conclusion. The actions detailed in the NNSA letter and brief to the Board provided in response to the Board's letter of March 5, 2008, have had a limited impact on resolving the issues noted in the Board's letter. Progress has been made in enhancing federal IPT oversight, membership involvement, and availability of resources. The design process has improved with respect to ensuring that requirements are incorporated into the design. The project is adopting the use of DOE Standard 1189 and the HAZOP technique. However, none of these actions have been accomplished in a thorough or timely manner, limiting their effectiveness in contributing toward robust project management or a design process that readily integrates safety into the design.