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# DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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May 3, 2004

The Honorable Jessie Hill Roberson  
Assistant Secretary for Environmental Management  
U.S. Department of Energy  
1000 Independence Avenue, SW  
Washington, DC 20585-0113

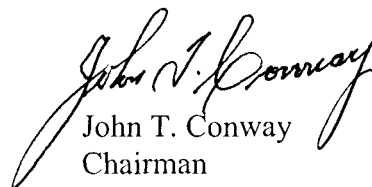
Dear Ms. Roberson:

On November 18, 2003, the Department of Energy (DOE) approved a Basis for Interim Operation (BIO) for the Mobile Waste Characterization and Loading Units for the Central Characterization Project at the Waste Isolation Pilot Plant, and authorized use of this BIO at more than 28 sites without further analysis. This safety basis was intended to comply with the requirements of the Nuclear Safety Management rule (10 Code of Federal Regulations Part 830). It authorizes activities that include waste handling and staging, characterization, nondestructive assay and examination, head-space gas sampling, visual examination and repackaging, and TRUPACT-II loading activities.

The staff of the Defense Nuclear Facilities Safety Board (Board) reviewed this BIO and some of its supporting documents and identified significant technical deficiencies. The issues identified include quality assurance-related issues, such as technical errors; incorrect modeling of accident scenarios; lack of proper documentation of accident analyses; and potentially inadequate identification and classification of controls for protection of the public and workers. These issues, as documented in the enclosed report, were discussed with some of the authors of the BIO during a meeting held on March 5, 2004, at Lawrence Livermore National Laboratory.

The Board is concerned that waste operations using the controls in this safety basis, as authorized in your November 18, 2003 letter, may not adequately protect the public and workers. Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a report within 45 days of receipt of this letter that documents (1) an independent assessment of the adequacy of the BIO, documented in a Safety Evaluation Report; (2) a plan and schedule for correcting the deficiencies and shortcomings identified in the enclosed report; (3) an assessment of ongoing activities that may have used a similar safety basis; and (4) actions that will be taken to identify an adequate set of controls for the ongoing activities until a technically justifiable safety basis has been prepared and approved.

Sincerely,

  
John T. Conway  
Chairman

c: Mr. Mark B. Whitaker, Jr.

Enclosure

# DEFENSE NUCLEAR FACILITIES SAFETY BOARD

## Staff Issue Report

March 25, 2004

**MEMORANDUM FOR:** J. K. Fortenberry, Technical Director

**COPIES:** Board Members

**FROM:** F. Bamdad, D. Ogg

**SUBJECT:** Authorization Basis for the Waste Isolation Pilot Plant Mobile Characterization Units

This report documents observations made by the staff of the Defense Nuclear Facilities Safety Board (Board) during a review of a safety basis document approved by the Department of Energy's (DOE) Office of Environmental Management (EM). This safety basis was prepared for the Mobile Waste Characterization and Loading Units (Mobile Units) for the Central Characterization Project at the Waste Isolation Pilot Plant (WIPP). Staff members F. Bamdad, D. Kupferer, C. March, M. Merritt, D. Ogg, R. Robinson, and W. Von Holle participated in this review. On March 5, 2004, the staff attended a meeting at Lawrence Livermore National Laboratory to discuss the technical contents of the supporting documents for the safety basis with the responsible analysts.

**Background.** On November 18, 2003, EM approved a Basis for Interim Operation (BIO) for the WIPP Mobile Units and authorized its use as the safety basis at more than 28 sites throughout the defense nuclear complex without performing any additional analyses. The BIO applies to the retrieval, staging, handling, characterization, and repackaging of transuranic (TRU) waste, and is intended to comply with the requirements of the Nuclear Safety Management rule (10 Code of Federal Regulations [CFR] Part 830, [10 CFR Part 830]). The BIO is augmented by an Application Guide that identifies the site-specific conditions to be met prior to implementation of the BIO and operation of the Mobile Units.

DOE's approval relies on many years of experience with such activities and assumes that operation of the units would not constitute an initial startup. DOE instead categorizes operation of the WIPP Mobile Units as a restart of an approved operation/activity which represents a facility modification. Accordingly, DOE concludes that a Readiness Assessment could be used to approve the activities instead of an Operational Readiness Review (ORR). The Application Guide contains a checklist for the performance of such a Readiness Assessment.

Preparing a generic safety basis for similar activities at different sites may be a valuable tool for achieving consistency and may save resources, but the Board's staff has identified several deficiencies that raise concern regarding the technical quality of this document.

**Basis for Interim Operation.** The BIO identifies and evaluates the hazards associated with operations involving waste handling, staging, characterization, nondestructive assay and examination, head-space gas sampling, visual examination, repackaging, and TRUPACT-II loading activities. Some hazardous events are carried forward for quantitative accident analyses and potential identification of safety-related systems. Although no safety-class systems are identified in the BIO, some design features are designated as safety-significant to protect workers from significant consequences of potential events. Additionally, the BIO takes credit for several administrative control programs.

The staff noted several deficiencies in the BIO. Some of these deficiencies are general, while others relate specifically to a drum deflagration accident.

### *General Deficiencies*

- The hazard analysis is based on the assumption that the TRU waste is contained in Department of Transportation qualified Type-A containers. These containers are identified as safety-significant design features in the Technical Safety Requirements (TSR), and a maintenance program is expected to be in place for inspection of their integrity and verification of the presence of a filtered vent to prevent the accumulation of hydrogen gas generated by radiolysis. Many defense nuclear facilities capable of using this BIO may not meet this expectation, and may have a significant number of containers that lack vents to release the hydrogen. Therefore, the BIO specifies (in Chapter 3, Table 3-6) that a programmatic administrative control—a Container Inspection Program—be in place that “provides visual surveillance and inspection of drums to identify signs of pressurization or degradation that could challenge drum integrity.” This control is also reflected in Appendix B, “Process Hazard Analysis.” However, Section 5 of the TSR, “Administrative Controls,” includes no such program.
- The BIO calculates the unmitigated consequences of a fire involving TRU waste in a glovebox to be about 15 rem to a member of the public at 200 meters. The evaluation guideline for identification of safety-class systems is set by DOE at 25 rem. DOE directives, however, state that 25 rem is not to be used as a “hard” pass/fail level. Instead, unmitigated releases should be compared with 25 rem to determine whether they challenge the evaluation guideline, and if so, safety-class systems for protection of the public should be identified. The BIO, however, does not identify any safety-class systems despite the uncertainties associated with the predicted dose consequences.
- The dose consequence calculations provided in the BIO do not appear to be supported by a well-documented analysis. The BIO does not reference any documents for plume dispersion or other analyses related to the dose consequences for the public or collocated workers. Participants in the meeting at Lawrence Livermore National

Laboratory stated that the dose consequence analyses had not been documented in a reference suitable for review by the Board's staff.

- Appendix D to 10 CFR Part 830 indicates that "DOE will review the contents and quality of the safety basis documentation... [and] DOE will prepare a Safety Evaluation Report (SER) to document the results of its review." EM did not prepare a SER for the approval of the BIO, and it is not clear how EM could have determined the adequacy of the BIO without proper documentation of the principal dose estimates.

### *Deficiencies in the Hydrogen Deflagration Analysis*

The BIO considers hydrogen generation and accumulation in the drums to be a credible event and analyzes hydrogen deflagration as a potential event. Treatment of the hydrogen deflagration event in the BIO, however, is technically deficient and may have resulted in an inadequate set of controls:

- Many of the activities authorized in the BIO involve close handling of hazardous materials by the workers. The BIO, however, does not appear to have adequately identified controls to protect them from potential hazards. For example, handling of unvented waste drums may result in hydrogen deflagration and release of radioactive material. For this event, the BIO and TSR identify combustible loading controls, inventory controls, emergency response, and training to protect the workers. Although some of these controls may reduce exposure to the workers, none appears adequate to fully protect the workers. The staff believes that it would be prudent for DOE to require, in the TSR, engineered controls for unvented drums. This level of control is particularly important during handling of the drums before they reach the Mobile Units where more robust engineered barriers are available and credited. Examples of controls for unvented drums found at some DOE sites include drum lid restraints, overpacking bulged or damaged drums, and segregating unvented drums from other drums.
- TSR Administrative Control 5.5.1, "Inventory Control," states that a TRU waste drum shall contain no more than 100 plutonium-equivalent curies (PE-Ci) and no more than 200 plutonium-239 fissile gram equivalents. However, in the BIO, Chapter 3, "Hazards Analysis," there are conflicting values for the quantity of material at risk in a TRU drum. For some accidents, TRU waste drums are assumed to contain 100 PE-Ci. On the other hand, the analysis for the drum deflagration accident uses a less-conservative value of 80 PE-Ci. The use of this latter value is not clearly explained, is in conflict with the TSR limit, and results in a dose consequence that is 20 percent below that which would otherwise be calculated.
- The BIO concludes that a hydrogen deflagration in the headspace of a drum would not ignite combustible wastes in the drum. This conclusion is based on an analysis

performed using the volumetric heat of combustion and calculating the energy generated from a hydrogen deflagration event. The calculation estimates the uniform temperature increase of a lump-sum mass of combustible materials inside the drum due to this energy, and concludes that the rise in temperature is not sufficient to exceed the exothermic pyrolytic decomposition temperature of the mass. Therefore, the BIO concludes that a fire would not ensue. However, the staff believes the lump-sum mass model used in this analysis is nonconservative. For example, the model does not take into account the varying porosity of the combustible materials, the surface area-to-mass ratio of the waste contents, and temperature gradients in the waste such that a minute amount of material could ignite, resulting in a drum fire. The staff believes that a conservative analysis would include these factors and conclude that a fire could occur following a deflagration in the drum. (It should be noted that a hydrogen deflagration in a waste drum occurred at the Idaho National Engineering and Environmental Laboratory in August 2003, and the ensuing fire consumed all the combustible materials not covered by dry cement before burning itself out.)

- Some of the references cited in the BIO appear to contain technical errors that went undetected during the review and approval process. For example, the radiolytic hydrogen generation rate (known as the G value) is based on beta-emitting materials and equals 0.5 molecule-hydrogen per 100 electron-volts absorbed energy. The majority of the TRU waste generates alpha particles (e.g., plutonium-239). The correct G value for alpha-emitting materials is 1.1 molecules-hydrogen per 100 electron-volts absorbed energy.

**Operational Readiness.** DOE Order 425.1C, *Startup and Restart of Nuclear Facilities*, mandates that the initial startup of a new hazard category 1, 2, or 3 nuclear facility, or restart of a hazard category 1 or 2 nuclear facility, requires an ORR. The WIPP Mobile Unit operations are categorized as a hazard category 2 nuclear facility because of the substantial amount of radioactive materials involved in the activities. EM, however, authorized the sites to perform a Readiness Assessment once the common elements of the safety basis have been implemented and verified. It should be noted that the activities involved in use of the WIPP Mobile Units may never have been performed at some of these 28 sites; moreover, the systems and equipment involved in the activities need to be set up at each site, and TSR implementation must be verified independently for each operation. Therefore, performance of a Readiness Assessment may not meet the requirements of DOE Order 425.1C or be adequate to ensure safety.

Of note, workers at Lawrence Livermore National Laboratory are using the WIPP Mobile Units at the Decontamination and Waste Treatment Facility. Personnel from the National Nuclear Security Administration's Livermore Site Office performed an ORR to authorize the startup of operations, as required by DOE Order 425.1C. This ORR identified several pre-start findings, thus demonstrating the necessity of a thorough review before startup of similar operations at other sites.