

A.J. Eggenberger, Chairman  
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## DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700 Washington, D.C. 20004-2901  
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February 17, 2009

The Honorable Steven Chu  
Secretary of Energy  
U. S. Department of Energy  
1000 Independence Ave., SW  
Washington, DC 20585-1000

Dear Secretary Chu:

The Defense Nuclear Facilities Safety Board (Board) is pleased to enclose a copy of our Quarterly Report (No. 7) to Congress on the Status of Significant Unresolved Issues with the Department of Energy's Design and Construction Projects. In the Conference Report accompanying the FY 2007 National Defense Authorization Act, the conferees directed the Board to provide quarterly reports until the Department of Energy (DOE) and the Board submit a joint report "on their efforts to improve the timeliness of issue resolution, including recommendations, if any, for legislation that would strengthen and improve technical oversight of the Department's nuclear design and operational activities." The joint report was submitted to the congressional defense committees on July 19, 2007. While the conferees did not require the Board to continue providing quarterly reports, the Board believes these reports provide an appropriate means to keep all parties apprised of the Board's concerns with new designs for DOE defense nuclear facilities. The Board has received encouraging feedback from Congress. As such, the Board intends to continue issuing quarterly reports to Congress and DOE.

Sincerely,

A handwritten signature in black ink, appearing to read "A. J. Eggenberger". The signature is fluid and cursive, with a large initial "A" and "E".

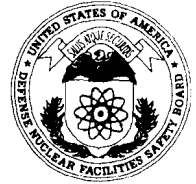
A. J. Eggenberger  
Chairman

Enclosure: as stated

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# DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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February 9, 2009

To the Congress of the United States:

On September 29, 2006, House Conference Report 109-702 on the National Defense Authorization Act for Fiscal Year 2007 (H.R. 5122) was released and approved by both houses of Congress. The Conference Report, Section 3201, directed the Defense Nuclear Facilities Safety Board (Board) to provide quarterly reports on the status of significant unresolved technical differences between the Board and the Department of Energy (DOE) on issues concerning the design and construction of DOE's defense nuclear facilities. While the specified direction does not require the Board to continue providing quarterly reports, the Board believes these reports provide an appropriate means to keep all parties apprised of Board concerns with new designs for DOE defense nuclear facilities. The Board has also been encouraged by the feedback received from the Congressional committees (e.g., Senate Report 110-77). As such, the Board intends to continue issuing these reports to Congress and DOE.

This is the seventh report, reflecting the status of the Board's concerns through the end of November 2008. It builds on earlier reports to summarize the status of concerns previously raised and identifies new concerns associated with the relevant projects. The status of many concerns has not changed significantly during the reporting period; however, the fact that a concern has not been resolved does not necessarily imply a lack of progress.

In this report, the term "unresolved concern" does not necessarily imply that the Board has a disagreement with DOE or believes DOE's path forward is inappropriate. Some of the concerns noted in these quarterly reports simply await final resolution through further development of the facility design. All of the significant unresolved concerns discussed herein have been communicated to DOE. Minor concerns that the Board believes can be resolved easily and for which an agreed-upon path forward exists are not included. The Board will follow these items as part of its normal design review process. It is important to note that the Board may identify additional concerns in the course of its continuing design reviews. New concerns identified since the previous quarterly report are noted below, as well as those concerns the Board believes have been resolved. For this reporting period, two new issues were identified, and five issues were resolved.

## **PROJECTS WITH THE MOST SIGNIFICANT UNRESOLVED ISSUES**

The Chemistry and Metallurgy Research Replacement Project at Los Alamos National Laboratory (LANL), highlighted in the last quarterly report, remains a concern to the Board. The Board is also highlighting an issue regarding protection of the final exhaust high-efficiency particulate air (HEPA) filters at the Waste Treatment and Immobilization Plant.

As noted below, the Chemistry and Metallurgy Research Replacement Project is addressing unresolved safety concerns. DOE and the Board have reached general agreement on the specific safety strategies for the issues of concern. The Board believes that satisfactory implementation of the specific safety strategies needs to be confirmed during its review of the preliminary design and Preliminary Documented Safety Analysis. This review should occur in the first quarter of next year. The 2009 National Defense Authorization Act, Section 3122, *Limitation on Funding for Project 04-D-125 Chemistry and Metallurgy Research Replacement Facility Project, Los Alamos National Laboratory, Los Alamos New Mexico*, requires the Board and DOE to submit a certification to the congressional defense committees that the concerns raised by the Board have been resolved before certain funds for the Chemistry and Metallurgy Research Replacement Project are made available. The Board and DOE have begun discussions regarding how the Board can provide such certification. The Board hopes to reach a final decision on certification by April 2009. This date is feasible if sufficiently complete data and information can be provided to the Board by DOE on a timely schedule. The Board will work with DOE to assist DOE in reaching this ambitious goal.

***Los Alamos National Laboratory, Chemistry and Metallurgy Research Replacement Project.*** In its first quarterly report, the Board noted its concern regarding the project's overall approach for selecting safety-related systems and establishing conservative design criteria for those systems. In the last quarterly report, the Board noted that progress has been made toward addressing the safety strategy for the Chemistry and Metallurgy Research Replacement project.

On May 30, 2008, the Board transmitted a letter to the National Nuclear Security Administration (NNSA) addressing its ongoing review of project design documentation and several specific design issues that require increased attention. NNSA currently anticipates proceeding into final design by June 2009. NNSA will complete a Technical Independent Project Review early in 2009. The Board has received the revised Preliminary Documented Safety Analysis and expects an updated design package in January 2009. As reported in the last quarterly report, the Board will undertake its own detailed independent review of the Preliminary Documented Safety Analysis and design of safety-related systems and will, once it is completed, evaluate the adequacy of NNSA's Technical Independent Project Review. These actions will form the technical basis for the Board's certification.

***Hanford Site, Waste Treatment and Immobilization Plant.*** In the Board's sixth Quarterly Report to Congress dated September 25, 2008, the Board described a new issue associated with fire safety design for ventilation systems and the development of an alternative

means of protecting the final exhaust HEPA filters of the confinement ventilation systems equivalent to those described in DOE Standard 1066, *Fire Protection Design Criteria*.

On October 14, 2008, the Board met with DOE to discuss the approach being taken to demonstrate equivalency to DOE Standard 1066. DOE plans to use analytical models to demonstrate equivalent protection of the HEPA filters. In order to demonstrate equivalency, many of these models will require considerable development (some do not currently exist) or will require considerable modification to be fully representative of the fire scenarios at the Waste Treatment Plant. DOE is currently developing these analytical models and plans to apply these tools on a case-by-case basis to the four nuclear facilities, i.e., Pretreatment, High Level Waste, Low Level Waste, and Analytical Laboratory. DOE is making plans to perform a limited amount of testing to validate these models but, at the time of the Board's discussion with DOE, the testing methodology and acceptance criteria were not well defined. DOE has engaged suitable experts to assist them in developing the equivalent approach and evaluating the new analytical models. However, the Board is concerned that DOE may not be able to develop an adequate scientific basis to support the analytical models within a reasonable time and cost. The cost and schedule impacts could be significant if the analytical models prove to be unacceptable. The Board has discussed using an alternative approach with DOE that could result in avoiding the need to conduct tests with uncertain outcome, cost and schedule. DOE is currently investigating the validity of these approaches. The Board expects to review DOE's new technical basis during the first half of 2009.

## **NEW ISSUES IDENTIFIED DURING THE PERIOD**

### **1. Project: Los Alamos National Laboratory, Transuranic Waste Facility**

The new Transuranic Waste Facility project being planned at the LANL will consolidate handling of solid transuranic waste that is currently conducted in several locations. The proposed facility has five functions: staging and storage, characterization, packaging and repackaging, utilities, and shipping to the Waste Isolation Pilot Plant in Carlsbad, New Mexico. This project is seeking NNSA approval of the conceptual design for its selected alternative (Critical Decision 1). Due to the issue noted below, the Board cannot accept the project's safety posture. The existing conceptual design does not meet the safety-in-design expectations necessary to proceed to the next design phase.

*New Issue—Inadequate integration of safety into the design process.* The current conceptual design of the Transuranic Waste Facility project does not demonstrate an adequate integration of safety into the design. The project team has not developed

adequate information and design specificity for its safety systems, and several of the safety controls do not meet requirements. Specific issues include:

- The proposed safety control strategy in the preliminary hazards analysis relies on a safety-class structure and a safety-class fire suppression system. The conceptual design utilizes existing portable trailers that would be relocated to the planned site. Transuranic Waste Facility project personnel were unable to provide supporting evidence that the trailers could be designed to meet the required safety functions for these systems identified in the preliminary hazards analysis. Of particular concern is the ability of these trailers to withstand all natural phenomena hazards.
- The identified functional requirements for safety systems, including support systems, are inconsistent between the preliminary hazards analysis and other documentation included in the conceptual design package. For example, the electrical system that supports the safety-significant ventilation system had not been identified as being safety-significant in the preliminary hazards analysis. This would render the safety-significant ventilation system non-functional in a postulated natural phenomenon event.
- During activities that require opening drums or containers of radioactive materials, the conceptual design relies on placing workers in personal protective equipment rather than having an engineered control (e.g., glovebox) for worker safety. This is not consistent with the preferred hierarchy of safety controls for new facilities.
- A Technical Independent Project Review is intended to determine that the safety documentation is sufficiently conservative and bounding to be relied upon for the next phase of the project. The Technical Independent Project Review for this project was specifically directed not to look at nuclear safety in the conceptual design. As a result the Technical Independent Project Review did not perform an adequate assessment of safety in design.

**2. Project: Los Alamos National Laboratory, Safety System Upgrades at Technical Area 55**

As part of LANL's efforts to implement the Board's Recommendation 2004-2, *Active Confinement Systems*, and develop a safety basis for the Plutonium Facility in compliance with Title 10 of the Code of Federal Regulations Part 830, *Nuclear Safety Management*, an independent review was performed by the URS Corporation of the facility's safety systems. This independent review resulted in a set of recommended actions described in a memorandum to the Los Alamos Site Office dated June 26, 2008 from Los Alamos National Security, LLC. The recommended actions would strengthen the Plutonium Facility's overall safety posture through the elimination of recognized safety system vulnerabilities and improve the confinement strategy by transitioning to safety-class

active confinement ventilation within the next 3 to 5 years. The recommended actions include several subprojects currently under the Technical Area-55 (TA-55) Reinvestment Project, as well as many actions funded and managed through other means using the Integrated Priority List process. As discussed in the last quarterly report, the Board has decided to oversee these efforts as a whole, rather than attribute concerns specifically to the TA-55 Reinvestment Project.

***New Issue—Inadequate approach to ensure timely improvements to the safety posture.*** LANL currently envisions implementing the recommended actions from the memorandum dated June 26, 2008, through an Integrated Priority List process. In practice, however, the Board has observed that the Integrated Priority List process is used by LANL managers to deconflict limited resources and schedule a broad range of activities from programmatic equipment upgrades to facility maintenance activities. Therefore, listing an activity or project on the Integrated Priority List process alone does not ensure that the fundamental principles recognized by DOE as necessary for successful project execution (as outlined in DOE Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets*) are met. In particular, this includes ensuring that the upgrades are appropriately funded. As a result, the Board lacks confidence that the safety system vulnerabilities will be eliminated and the safety posture improved in a timely manner. The Board notes that the Los Alamos Site Office, in its recent approval of the safety basis for the Plutonium Facility, directed the contractor to develop an integrated project management plan to implement the improvements discussed in the safety basis. This represents an opportunity to apply DOE's best management practices.

## ISSUES RESOLVED DURING THE PERIOD

### 1. **Project: Nevada Test Site, Device Assembly Facility—Criticality Experiments Facility**

***Issue—Structural Cracks.*** The Device Assembly Facility (DAF) structure has numerous cracks in the concrete that are considered abnormal for a nuclear facility. The Board was concerned that the extensive cracking could have been an indicator of poor construction practices that had adversely affected the concrete's in situ strength. Degraded concrete strength could potentially result in failure of the structure in a design basis seismic event. The Board suggested that a non-destructive comparative evaluation of cracked and uncracked portions of the facility be performed to eliminate this concern.

***Resolution—***A comparative evaluation of the cracked and uncracked portions of DAF was recently performed using a rebound hammer test, which provides an indication of concrete strength. A statistical analyses of the test results concluded that the cracked and uncracked concrete have comparable strength. The Board considers this issue closed.

## 2. **Project: Idaho National Laboratory, Integrated Waste Treatment Unit**

**Issue—Pilot Plant Testing.** Early in the design process, the expected disposition path was to send a carbonate waste form to the Waste Isolation Pilot Plant in Carlsbad, New Mexico. In the event this path was not available, the plan was to produce a mineralized waste form for disposal at a geological repository. The Board encouraged DOE to conduct testing using a pilot plant to produce both carbonate and mineralized waste forms, allowing the evaluation of the safety aspects of each operation. During this testing, an over-temperature condition developed in the charcoal adsorber bed. A root-cause investigation into the over-temperature event was required to identify safety-significant controls to protect facility workers from a mercury release.

**Resolution—**The carbonate waste form was selected for the project. The pilot plant test results demonstrated that no additional safety controls were required if the mineralized waste form was selected in the future. The investigation of the over-temperature event in the charcoal adsorber bed of the pilot plant identified the root-cause and proposed controls to prevent/mitigate such an occurrence in the facility. The Board believes the identified controls are adequate and considers this issue closed.

**Issue—Waste Characterization.** Further characterization of the waste was needed to validate the safety basis assumptions regarding the radionuclide content of the waste. This characterization ensures that the Integrated Waste Treatment Unit will be operated within the bounds of its safety basis.

**Resolution—**Additional sampling data was compiled and analyzed. Evaluation of the accident consequences, assuming the worst case inventory from the various waste tanks, shows that even with this very conservative assumption, the control strategy for the facility is adequate. The Board considers this issue closed.

**Issue—Distributed Control System Design.** The Board was concerned that DOE had not demonstrated that the Distributed Control System design was capable of placing the process in a safe configuration if operational safety limits were exceeded or if the system failed (e.g., during a seismic event). Additionally, the ability of the system to monitor process conditions following an earthquake needed to be assured.

**Resolution—**The design now separates the safety-related control functions from other process controls and isolates the power supply for safety-related components from the power supply for other systems. These features preclude non-safety-related systems from affecting the safety-related control system. DOE incorporated ANSI/ISA Standard 84.00.01, *Safety Instrumented Systems for the Process Industry Sector*, into the project's design requirements to better ensure the operational reliability of the safety-related control system. The fail-safe design of the safety-related control system, in combination with the non-safety-related seismic switches and emergency response procedures,

provides adequate technical justification for not incorporating post-seismic monitoring capability into the design. The Board considers this issue closed.

**3. Project: Savannah River Site, Waste Solidification Building**

*Issue—Preliminary Documented Safety Analysis Deficiencies.* The Board raised two issues with the Preliminary Documented Safety Analysis for the Waste Solidification Building (WSB): (1) the criterion used to analyze hydrogen explosion scenarios in unvented pipes and vessels did not preserve the confinement integrity of the primary boundary, and (2) it was not clear what impact the application of DOE Standard 1189 would have on identification of safety-related controls, particularly for chemical hazards.

*Resolution—*NNSA directed the WSB project to revise its hydrogen explosion calculations and modify the Preliminary Documented Safety Analysis to address the two Board issues. Pipes and vessels will be qualified such that they will maintain confinement and not yield under a hydrogen explosion scenario. In addition, corrosion rates have been modified to more realistic values, which the project committed to confirming through a surveillance program. With regards to the second issue, a chapter has been added to the Preliminary Documented Safety Analysis that demonstrates the project's compliance with DOE Standard 1189. Within this chapter, seven new potential accident scenarios with potential chemical consequences to workers were identified, however, it was determined that existing controls were adequate for those new scenarios.

*Additional Comment—Red Oil.* Since the last quarterly report, the potential for a red oil explosion has been identified by the WSB project. The original waste acceptance criteria assured that the waste material being transferred to WSB from the Mixed-Oxide Fuel Fabrication Facility would have a very low level of organic material. The Mixed-Oxide Fuel Fabrication Facility can no longer assure the waste would have this low level of organic material and the waste acceptance criteria has been revised appropriately. The WSB project now considers a red oil explosion to be a credible design basis accident. The Board believes that the WSB project has taken appropriate actions by identifying the need for a safety-class control. The Board will review the red oil controls as they are further developed.



As directed by Congress, the Board will continue to exercise its existing statutory authority.

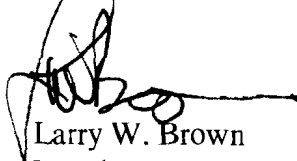
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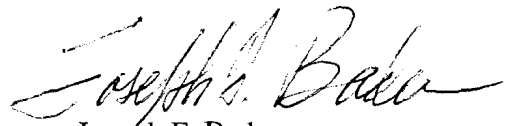
A. J. Eggenberger  
Chairman



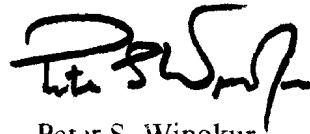
John E. Mansfield  
Vice Chairman



Larry W. Brown  
Member



Joseph F. Bader  
Member



Peter S. Winokur  
Member

Enclosure

bcc: Mark Whitaker

**ENCLOSURE**

**SEVENTH QUARTERLY REPORT  
SUMMARY OF SIGNIFICANT UNRESOLVED ISSUES  
WITH NEW DEFENSE NUCLEAR FACILITIES**

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES <sup>b</sup>
			Critical Decision Approved	Design Completion <sup>a</sup>	Construction Completion	
Hanford Site	Waste Treatment and Immobilization Plant	12,263			<i>(Operational 2019)</i>	
	a. Pretreatment Facility		CD-3	67%	25%	1. Seismic ground-motion— <i>resolved</i> (4) 2. Structural engineering 3. Chemical process safety— <i>resolved</i> (3) 4. Fire safety design for ventilation systems
	b. High Level Waste Treatment Facility		CD-3	86%	21%	1. Seismic ground-motion— <i>resolved</i> (4) 2. Structural engineering 3. Fire protection 4. Fire safety design for ventilation systems
	c. Low Activity Waste Facility		CD-3	95%	63%	1. Fire protection
	d. Analytical Laboratory		CD-3	91%	55%	1. Fire protection
	Demonstration Bulk Vitrification System Project	224	CD-1	95%	<i>(Operational to be determined)</i>	1. Confinement strategy— <i>resolved</i> (5) No design issues remain
	Interim Pretreatment System	182–310	CD-0	<5%	<i>(Operational 2014)</i>	No issues identified

a. Percent of design complete is an estimate of completion for the particular stage of design, i.e., if CD-0 is approved the percent represents the completion of conceptual design, if CD-1 is approved the percent represents the completion of preliminary design, if CD-2 is approved the percent represents the completion of final design, if CD-3 is approved the design is typically 90% or greater of the final design.

b. Numbers in parentheses indicate the quarterly report in which an issue was considered resolved or a new issue was identified.

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES <sup>b</sup>
			Critical Decision Approved	Design Completion <sup>a</sup>	Construction Completion	
Hanford Site (continued)	K-Basin Closure Sludge Treatment Project	220 (Estimated using new conceptual design)	Returned to CD-0	0%	<i>(Operational to be determined)</i>	1. Completeness of Preliminary Documented Safety Analysis —review terminated; document not relevant to new conceptual design (3) 2. Adequacy of project management and engineering
	Large Package and Remote Handled Waste Packaging Facility	390	CD-0	0%	Deferred <i>(Operational to be determined, post-2016)</i>	No issues identified
	Tank Retrieval and Waste Feed Delivery System	1,140	One subproject not using the formal CD process	Various degrees of completion	Various degrees of completion and operations	1. Design pressure rating of waste transfer system —resolved (3) No issues remain
	Immobilized High-Level Waste Interim Storage Facility	100	CD-3	90%	Deferred <i>(Operational to be determined)</i>	No issues identified
Idaho National Laboratory	Integrated Waste Treatment Unit Project	570.9	CD-3	>90%	20% <i>(Operational 2011)</i>	1. Pilot plant testing —resolved (7) 2. Waste characterization —resolved (7) 3. Distributed control system design —resolved (7)
Los Alamos National Laboratory	Chemistry and Metallurgy Research Replacement Project	725-975 (Being reevaluated)	CD-1	90%	Some ground work <i>(Operational 2016)</i>	1. Design-build-acquisition strategy —resolved (2) 2. Site characterization and seismic design 3. Safety-significant active ventilation system —resolved- (2) reopened because of issue 6 (3) 4. Safety-class fire suppression system 5. Safety-class and safety-significant container design 6. Deficiencies in Draft Preliminary Documented Safety Analysis

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES <sup>b</sup>
			Critical Decision Approved	Design Completion <sup>a</sup>	Construction Completion	
Los Alamos National Laboratory (continued)	Technical Area-55 Reinvestment Project	72	Phase A: CD-2; Phase B: CD-0	Various degrees of completion	(Complete 2010) (Complete 2015)	1. Adequacy of safety systems— <i>resolved</i> (6) 2. Inadequate approach to ensure timely improvements to the safety posture— <i>new issue</i> (7)
	Upgrades to Pit Manufacturing Capability at Technical Area-55	Annual funding	Not formally implementing CD process	Various degrees of completion	Work ongoing	1. Lack of adherence to DOE Order 413.3A— <i>resolved</i> (6)
	Radioactive Liquid Waste Treatment Facility Upgrade Project	119–172	CD-1	35%	(Operational 2014)	1. Weak project management and federal project oversight 2. Weak integration of safety into the design process
	New Solid Transuranic Waste Facility Project	133–199	CD-0	60%	(Operational 2012)	1. Inadequate integration of safety into the design process— <i>new issue</i> (7)
	Nuclear Material Safeguards and Security Upgrades Project, Phase 2	240	CD-1	30%	(Operational 2013)	No detailed review completed
	Technical Area-55 Radiography Project	38	CD-0	90% On hold	<i>On hold</i>	No detailed review completed
Nevada Test Site	Device Assembly Facility—Criticality Experiments Facility	150	CD-3	100%	85% (Operational 2010)	1. Structural cracks— <i>resolved</i> (7) 2. Deficiencies in fire protection system
Oak Ridge National Laboratory	Building 3019—Uranium-233 Downblending and Disposition Project	477	CD-2/3A	60%	(Operational 2012)	1. Deficiencies in Preliminary Documented Safety Analysis
Pantex Plant	Weapon Surveillance Facility (previously called Component Evaluation Facility)	112	CD-0	On hold	(Operational on hold)	No detailed review completed

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES <sup>b</sup>
			Critical Decision Approved	Design Completion <sup>a</sup>	Construction Completion	
Savannah River Site	Pit Disassembly and Conversion Facility	2,400–3,200	CD-1	50%	<i>(Operational on hold)</i>	1. Assumption on combustible loading for seismically induced fire
	Salt Waste Processing Facility	1,340	CD-3	90%	Facility concrete placement started <i>(Operational 2013)</i>	1. Geotechnical investigation— <i>resolved (4)</i> 2. Structural evaluation 3. Quality assurance— <i>resolved (2)</i> 4. Hydrogen generation rate
	Plutonium Preparation Project	340–540	CD-1A	10%	<i>(Operational 2014)</i>	No issues identified
	Waste Solidification Building	345	CD-2/3	90%	<i>(Operational 2013)</i>	1. Structural design 2. Deficiencies in Preliminary Documented Safety Analysis— <i>resolved (7)</i>
Y-12 National Security Complex	Highly Enriched Uranium Materials Facility	549	CD-3	100%	92% <i>(Operational 2009)</i>	1. Water supply for fire-protection system— <i>resolved (6)</i>
	Uranium Processing Facility	1,400–3,500	CD-1	10%	<i>(Operational 2017)</i>	1. Preliminary hazards analysis development— <i>resolved (2)</i> 2. Noneconservative values for airborne release fraction and respirable release fraction— <i>resolved (6)</i>