EIGHTH ANNUAL REPORT

TO CONGRESS

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

FEBRUARY 1998

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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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February 17, 1998

To the Congress of the United States:

The Defense Nuclear Facilities Safety Board (Board) is pleased to submit to the Congress its annual report for calendar year 1997. The Board is an independent executive branch establishment responsible for providing advice and recommendations to the Secretary of Energy regarding public health and safety issues at Department of Energy (DOE) defense nuclear facilities, and the President if necessary.

As required by statute, the Board's report summarizes activities during calendar year 1997, assesses improvements in the safety of DOE defense nuclear facilities, and identifies remaining safety problems.

Initiatives fostered by the Board during the past several years regarding the way DOE manages the safety of operations at defense nuclear facilities are taking hold. The Board is beginning to see the fruits of its emphasis on Integrated Safety Management across the defense nuclear complex. Although there are still variances in progress at the individual sites and facilities, the Board is encouraged by the improvement.

Respectfully submitted,

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Vice-Chairman

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Member

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John E. Mansfield
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PREFACE

The Atomic Energy Act of 1954 as amended (Section 316) requires the Defense Nuclear Facilities Safety Board (Board) to submit to the Committees on Armed Services and on Appropriations of the Senate and to the Speaker of the House of Representatives a written report each year concerning its activities. In addition to setting forth all recommendations made by the Board during the preceding year, the Annual Report is required to include an assessment of:

(A) the improvements in the safety of Department of Energy defense nuclear facilities during the period covered by the report;

(B) the improvements in the safety of Department of Energy defense nuclear facilities resulting from actions taken by the Board or taken on the basis of the activities of the Board; and

(C) the outstanding safety problems, if any, of Department of Energy defense nuclear facilities.

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EXECUTIVE SUMMARY

The safety of Department of Energy (DOE) defense nuclear facilities continued to improve during 1997 despite increased hazards associated with the stabilization of highly radioactive substances remaining from previous operations and the decommissioning and decontamination of highly contaminated facilities.

Initiatives fostered by the Defense Nuclear Facilities Safety Board (Board) during the past several years regarding the way DOE manages the safety of its operations are taking hold at the defense nuclear facilities. The early progress would not have been possible without fundamental and substantial changes in facility operations and departmental internal oversight activities—changes described in the Board's previous Annual Reports—that have come about largely as a result of DOE's affirmative responses to the Board's activities and recommendations.

The Board continues to focus on its statutorily mandated responsibilities to review and analyze facility and system design, operations, practices, and events, and to make recommendations to the Secretary of Energy that are necessary to ensure adequate protection of the health and safety of workers and the public. Among these responsibilities are the review and evaluation of health and safety standards, including DOE's orders, rules, and other safety directives pertaining to the design, construction, operation, and decommissioning of defense nuclear facilities. In recent years, the Board has recast its past initiatives into a comprehensive, strategic emphasis on the development and implementation of an Integrated Safety Management System for all defense nuclear facilities. Priority attention has been placed on operating facilities that conduct weapons-related research and development, weapons surveillance and dismantlement, weapons component testing and storage, and activities associated with the stabilization of plutonium and uranium residues. During this past year, the Board has seen significant progress, as this report describes.

Because of the close relationship resulting from the Board's sole function of oversight of the safety of DOE's defense nuclear facilities, the Board's accomplishments must be listed as DOE's accomplishments in connection with the action-forcing work of the Board. These accomplishments are detailed below.

1. In response to Board Recommendation 94-1, DOE has committed to the stabilization and packaging of a broad spectrum of radioactive and chemically unstable residues and transuranic materials. Under the close safety oversight of the Board and its staff, DOE has made progress in the following areas:

   - Stabilized more than 10,000 liters of plutonium nitrate solution in Building 371 at the Rocky Flats Environmental Technology Site.

- Stabilized more than 5,000 liters of low-level plutonium solutions in Building 774 at Rocky Flats.

- Completed draining of all high-level and low-level plutonium solutions from tanks in Building 771. Draining of all tanks in Building 371 at Rocky Flats should be completed this year, at which point all tanks containing plutonium solutions at Rocky Flats will have been drained.

- Completed dissolution of failed EBR-II spent nuclear fuel and deteriorating Mk-31 target elements in F-Canyon, as well as stabilization of the resulting plutonium solutions in FB-Line, at the Savannah River Site.

- Completed preparations and a readiness assessment for stabilization of salt residues in Building 707 at Rocky Flats.

- Completed stabilization of all ion exchange resin- and acid-contaminated leaded glove residues at Rocky Flats.

- Completed installation of bagless transfer equipment in FB-Line at Savannah River and procurement of stabilization and repackaging equipment at Rocky Flats for repackaging of plutonium metal.

- Restarted H-Canyon to stabilize deteriorating Mk-16/22 spent nuclear fuel.

2. During 1997, the Board and its staff engaged in an extensive review of the safety of plutonium pit storage at the Pantex Plant. This review focused high-level DOE attention on pit safety issues, with the following subsequent safety improvements:

   - The weapons design agencies developed a draft pit storage specification with moisture controls to minimize pit corrosion and will require the pits to be stored in sealed containers, which will provide a second barrier to release of plutonium during postulated accidents.

   - DOE established a goal of having all the pits in a dry environment within 3 to 4 years, to reduce pit corrosion.

   - DOE agreed to increase the number of Zone 4 magazines with active cooling and to discontinue efforts to consolidate surplus pit storage in a single building. Despite intensive study, DOE had not shown that this consolidation would have provided a net safety improvement.

- DOE committed to the development of an integrated pit storage program plan, which should lead to the logical development of effective requirements and increased high-level management attention on issues related to safe pit storage.

3. The Board's Recommendation 96-1 had urged DOE to defer operation of the In-Tank Precipitation Facility at the Savannah River Site until more thorough research could better demonstrate the safety of the process. Following completion of this research, DOE informed the Board that preparations to start these operations had been suspended because of concerns over safety and process effectiveness. The Board had questioned process safety at this facility, which separates cesium and other radioactive isotopes from high-level waste liquids. DOE intends to investigate alternatives to the In-Tank Precipitation Facility during the coming year. The Board also plans to evaluate the interim waste management activities that will be required to accommodate the delays in waste pretreatment at the Savannah River Site.

4. The Board and its staff have continued to review the content and implementation of safety basis documents at the Pantex Plant. For the last few years, DOE has used the Seamless Safety (SS-21) process to guide the development of safety bases for nuclear weapons assembly, disassembly, and surveillance operations. Dismantlement of the B61 Mods 0, 2, and 5, which was the pilot project for operations conducted in accordance with the analyses and controls derived from a Hazards Analysis Report, was completed safely in 1997. The first program to fully implement SS-21, the W69 Dismantlement Program, started in 1997. The W69 dismantlement operation is widely regarded as the best nuclear weapon dismantlement process designed to date.

5. In response to Board Recommendation 95-2 on Integrated Safety Management and continued active Board oversight, DOE has made substantial progress in institutionalizing this concept for complex-wide application and implementation on an initial group of operational facilities. The following are highlights of DOE progress in this area:

   - Issued Policy P450.4, which affirmed the Secretary's commitment to integrated work planning/safety planning and to Integrated Safety Management for protection of the public, workers, and the environment.

   - Issued a revision to its major system acquisition regulation, Department of Energy Acquisition Regulation (DEAR) 970.5204-2, to require contractors to develop and implement Integrated Safety Management Systems as a requirement in existing major Management and Operating contracts, as well as in future contracts.

   - Included key elements of Integrated Safety Management in DOE's 1998 Strategic Plan.

   - Issued a Safety Management Guide for Integrated Safety Management Systems.

- Made additional progress in defining the assignment of functions, responsibilities, and authorities for safety management.

- Began efforts to verify adequate contractor implementation of Integrated Safety Management Systems at a number of defense nuclear facilities, including the Savannah River Site H- and F-Canyons and Rocky Flats. Significant lessons were learned through these initial efforts with regard to both Integrated Safety Management System implementation and the DOE verification process itself.

- Initiated assessment of the status of key elements of Integrated Safety Management Systems at all defense nuclear facilities involving activities with substantial quantities of radioactive materials.

  – DOE, the Pantex contractor, and the weapons design laboratories have developed an integrated safety process that significantly improves on the approach used at the Pantex Plant to develop methods for assembling, disassembling, and testing nuclear weapons. Improvements were made in all aspects of safety management, most notably in strengthening line management's responsibility for safety.

  – DOE and the Y-12 Plant contractor have continued to improve the analysis of hazards and designation of safety controls to support the restart of Enriched Uranium Operations in Buildings 9212 and 9215. This improved set of safety controls, derived from sound hazard analysis, is a clear step forward for the restart effort in this key aspect of Integrated Safety Management.

  – DOE and Lawrence Livermore National Laboratory began a concerted effort to strengthen work planning, work control, and feedback and improvement at the laboratory's Plutonium Facility, Building 332.

  – DOE and Los Alamos National Laboratory initiated a focused effort to strengthen hazard analysis and control of the safety envelope at the Chemistry and Metallurgy Research facility.

  – DOE-Nevada demonstrated initiative by working to develop an Integrated Safety Management System for subcritical experiments at the Nevada Test Site, even though these experiments were not on the list of priority focus areas specified in the DOE implementation plan for Recommendation 95-2. DOE-Nevada also issued standards and manuals of practice to define expectations and controls for nuclear explosive safety at the Nevada Test Site.

  – Managers of the tritium facilities at the Savannah River Site continued to improve their impressive feedback and improvement process by strengthening their self-

assessments and by integrating the DOE Facility Representatives into their overall assessment approach.

6. A critical activity in DOE's implementation plan for Recommendation 94-1 is the removal of deteriorating spent fuel from the K-Basins at Hanford and provision for its dry interim storage on site pending ultimate disposition. The Spent Nuclear Fuel Project, established to execute this activity, experienced significant delays during 1997. The Board's staff completed a detailed review of the project and identified a lack of sound project management as the significant cause of the delays. The Board issued this evaluation of the Spent Nuclear Fuel Project in DNFSB/TECH-17, *Review of the Hanford Spent Nuclear Fuel Project*, dated October 1997. DOE and its contractor have concurred in the conclusions of the report and are taking corrective actions.

7. The Board and its staff reviewed the implementation of controls associated with hazard mitigation and prevention for the restart of Enriched Uranium Operations at the Y-12 Plant. These reviews found that many controls that had been credited with mitigating or preventing dominant hazard scenarios were either ineffective or nonexistent. Reliance on these controls would have left the facility in a vulnerable condition in which unproven equipment would have been relied upon to perform a safety function. As a result of the Board's involvement and observations set forth in letters issued on September 16 and November 4, DOE and its contractor have developed and are implementing a process to ensure adequate implementation of controls and have remained on track to satisfy an important national security requirement.

8. While reviewing the potential hazards that lightning could present to nuclear explosive operations at Pantex, the Board and its staff determined that these hazards were not being comprehensively and consistently analyzed. Subsequently, the Board requested that DOE prepare a detailed technical report providing a comprehensive analysis of the hazards posed by lightning to nuclear explosive operations, the controls necessary to prevent and mitigate those hazards, and the path forward for implementing and preserving the identified controls. DOE's response, which is not yet completed, has already resulted in physical changes being made to the bays and cells at Pantex that have significantly improved lightning protection.

9. In late 1996, the Board's staff and DOE personnel jointly undertook to assess the adequacy of safety controls for special operations at Pantex, such as radiography of weapons and dynamic balancing of nuclear warheads. The Pantex contractor agreed with the assessment that the then current analyses and controls were inadequate and suspended the operations. During 1997, the Board interacted frequently with DOE to improve these conditions, including Board letters sent on March 14, April 24, and October 25. Throughout the year, the Board helped DOE, the weapons design agencies, and the Pantex contractor identify the hazards of concern and the appropriate controls. Both the

radiography facilities and the dynamic balancer are now back in normal operation with significantly improved safety controls.

10. As a result of numerous Board reviews, letters, and other actions in the last few years, the Plutonium Facility (TA-55) at LANL has been transformed from a facility with relatively informal and inadequate control of its safety envelope to one that is currently a model of Integrated Safety Management, particularly work planning and work control. In this evolution toward better safety management, DOE at one point halted operations at TA-55 for almost 3 months while improved safety management procedures were developed.

11. Review by the Board and its staff of the new authorization basis for the Savannah River high-level waste tank farms identified several problems, which have been corrected as a result of feedback from the Board to DOE:

- DOE-Savannah River intended to eliminate existing requirements to ventilate the tanks to prevent flammable gases from accumulating. After briefings and issuance of formal comments by the Board, DOE decided to continue requiring that the tanks be ventilated.

- DOE-Savannah River intended to implement the new safety controls before determining whether existing equipment in the tank farms was adequate to perform the required safety functions. After this problem was identified, DOE evaluated the differences between the old and new authorization bases, prioritized the backfit evaluation, and presented a defensible path forward for implementation of the new controls.

- In response to concerns raised by the Board regarding the consequences of certain accidents at the High-Level Waste Evaporators at the Savannah River Site, DOE refined the safety analyses to better define the risk of operating the evaporators. As a result of this effort, DOE established additional controls to improve the safety of evaporator operation. These included reducing the amount of time required to isolate high-pressure steam in the event of a steam tube rupture and establishing an operator action to isolate building ventilation so as to reduce the consequences of certain accidents.

- The Board found that the Savannah River process for tracking and resolving open safety issues allowed potentially serious safety issues, such as the accumulation of flammable gases in tank waste solids, to be studied for extended periods without entering the formal Unreviewed Safety Question Determination process to ensure that the tanks were in a safe condition. After this problem was identified, DOE took action to revise its issue resolution process and implemented formal safety controls in the tank farms for the open issues.

12. The Board has dedicated substantial time and resources to following closely the installation and startup of the tritium activities associated with the Non-Nuclear Weapons Reconfiguration program. Many of the activities associated with this program are new to Savannah River and in some cases introduce significantly different hazards from those that now exist in these facilities. For example, in response to the Board's concerns regarding the likelihood and consequences of potential explosion accident scenarios associated with the Environmental Conditioning Chambers, DOE has significantly improved the safety analyses and supporting documentation to provide a stronger basis for operating these chambers.

13. The Board issued Recommendation 97-1, which urged DOE to ensure the long-term safe storage of more than a ton of uranium-233 (which presents a unique and significant radiological hazard). DOE has accepted the Board's recommendation and is working to finalize a plan for taking aggressive near- and long-term actions to address the issues raised by the Board.

14. The Board issued Recommendation 97-2, on criticality safety, to bring DOE's attention to a basic set of safety-related issues regarding nuclear criticality control throughout the DOE defense nuclear complex. DOE is in the process of addressing these issues.

15. In response to Board Recommendation 93-5 and continued active Board oversight, DOE has made substantial progress in the sampling and characterization of the high-level waste tanks at the Hanford Site. A total of 126 of the 177 tanks has been sampled, leading to a significantly increased understanding of tank safety issues. Although work remains to officially close these safety issues, understanding of the potential for burns of the waste itself, as well as understanding of the generation, retention, release, and possible burn of flammable gas in the tanks, has improved greatly. The characterization data have contributed to the systematic identification of controls that are implemented as part of the authorization basis for the tank farms to prevent and mitigate such burns.

16. As part of its effort to institutionalize a systems engineering approach for the Tank Waste Remediation System in response to Board Recommendation 92-4, DOE has developed an overall program logic for this system. This program logic is fundamental to the integration and success of the system as it provides the critical path, prerequisites, and interfaces for all the projects that contribute to the ultimate remediation of the tank waste at the Hanford Site.

17. Review of plutonium-238 operations at Savannah River revealed that the site Management and Operating contractor intended to move significant quantities of plutonium-238 bearing material to a facility ill suited for its storage, as part of an effort to reduce overhead costs at the HB-Line facility. After this issue was reviewed by the Board and its staff, this course of action was not pursued further.

18. In response to the Board's observations and assessments indicating the need for more stringent fire protection measures and for a reduction in the vulnerability of the large quantity of tritium stored in reservoirs within a vault at Savannah River, DOE has mitigated the fire hazards by removing combustibles, isolating the vault air system from the adjoining building, and fabricating robust reservoir containers that are resistant to a collapse of the vault roof.

19. In response to Board Recommendation 92-2, DOE developed a comprehensive program guidance document, DOE-STD-1063-93, *Establishing and Maintaining a Facility Representative Program at DOE Nuclear Facilities*, dated August 1993. This standard borrowed heavily from similar successful programs operated by the Naval Nuclear Program and the Nuclear Regulatory Commission. This guidance has greatly assisted DOE in developing a cadre of Facility Representatives who have become significant contributors to the defense-in-depth of safety at defense nuclear facilities and are also instrumental to the discipline of operations in these facilities. Working closely with the Board's staff, DOE revised and issued a much improved DOE-STD-1063 in November 1997, incorporating many of the lessons learned thus far in the program.

20. Staff-to-staff interactions regarding the rigor of controls developed for hydrodynamics testing led to significant improvement in the quality of the Los Alamos National Laboratory's hazard and risk analyses and in the identification of controls to reduce risks. Commitments were obtained to implement more rigorous safety-related controls than were previously envisioned.

21. In response to Board Recommendation 95-1, DOE has taken significant actions to slow the degradation of cylinders containing depleted uranium hexafluoride (UF_6) from external corrosion. This effort includes approximately 50,000 cylinders containing more than 500,000 metric tons of depleted UF_6 in Oak Ridge, Tennessee; Portsmouth, Ohio; and Paducah, Kentucky. Substantial progress has been made in several areas, including the completion of (1) removal of cylinders from direct ground contact, (2) design and construction of new and improved cylinder storage yards, and (3) a pilot program at Paducah to demonstrate a method for recoating entire cylinders (approximately 2,200 cylinders have been recoated under this pilot program).

22. At the Hanford Site, there had been plans to overpack 16 damaged or off-specification capsules of cesium chloride, each containing about 50,000 curies of cesium-137, in an older type container (Type S). Partly as a result of questions raised by the Board's staff during reviews of the design and fabrication of the overpack, the contractor designed an improved overpack container (Type W) that provides better confinement of the highly radioactive material.

23. In response to Board and DOE criticism of Pacific Northwest National Laboratory operations in 1994, the laboratory initiated a 3-year Operational Improvement Program,

which fundamentally revised the way the laboratory managed its operations. Board Recommendation 95-2 and two technical reports (DNFSB/TECH-5 and -6) were substantial influences on this program. In 1997, the laboratory emerged from the program with a reengineered management system that makes the treatment of environment, safety, and health issues integral with the business of conducting research.

24. In response to Board Recommendation 94-3, the building structure and safety systems have been substantially upgraded to allow plutonium materials to be stored safely in Building 371 at Rocky Flats. In addition, Rocky Flats has developed, and is in the process of implementing, an improved authorization basis for the building.

25. Based on information obtained from the review by the Board's staff of ventilation systems at Rocky Flats, the Board sent a letter to DOE on October 30, 1997, identifying potential complex-wide health and safety issues, including degradation and damage to ventilation filtration systems that function to protect the health and safety of the public. In a January 15, 1998, letter to the Board, DOE acknowledged the potential safety vulnerabilities identified by the Board and committed to a complex-wide evaluation and correction of any problems identified.

None of the above advances could have been made without the full cooperation of DOE, in particular the Secretary and his senior secretarial officers, as well as senior corporate managers of DOE's major contractors. The Board's many accomplishments during the 8 years since its inception give full testimony to what can be done by a dedicated oversight agency—without high cost and without formal regulatory structures.

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1. INTRODUCTION

1.1 BACKGROUND

In the late 1980s, a number of public health and nuclear safety issues at aging defense nuclear facilities operated by the Department of Energy (DOE) led Congress to create the five-member Defense Nuclear Facilities Safety Board (Board). The Board, composed of "respected experts in the field of nuclear safety with a demonstrated competence and knowledge relevant to the independent investigative and oversight functions of the Board," began functioning in late October 1989 with the swearing in of the charter Board members. To help ensure adequate protection of the health and safety of the public and workers, the Board was empowered to oversee DOE's programs for management of the health and nuclear safety of its defense nuclear facilities. The Board sees as its greatest imperative to ensure that DOE safely carries out its mandate to maintain the nation's nuclear weapons stockpile.

The Board is responsible for independent oversight of all activities related to nuclear safety within DOE's nuclear weapons complex. Today, DOE is actively engaged in the disassembly of numerous nuclear weapons while maintaining the remaining weapons in the stockpile in a safe and reliable condition, and in the conduct of research to ensure the continued safety of DOE's stewardship of the stockpile. DOE also pursues safe disposition of fissionable material removed from dismantled weapons and of hazardous material remaining in facilities that abruptly ceased production activities more than 8 years ago. Many of DOE's current activities are associated with stabilization and safe storage of special nuclear materials, safe management of radioactive wastes, and cleanup of the extensive radioactive contamination of facilities and sites.

The law establishing the Board, 42 U.S.C. § 2286, *et seq.*, requires that the Board review and analyze facility and system design, operations, practices, and events, and make recommendations to the Secretary of Energy that are necessary to ensure adequate protection of public health and safety. In making recommendations, the Board must consider the technical and economic feasibility of their implementation, while the Secretary must report to the President and Congress if implementation of a recommendation is impracticable because of budgetary considerations. If the Board determines that there is an imminent or severe threat to public health and safety, it must transmit its recommendations to the President, as well as to the Secretaries of Energy and Defense.

In the legislative history of the Board's enabling statute, as well as in the act itself, Congress gave guidance on how it expected the Board to carry out its functions. Congress provided action-forcing powers to the Board, so that the Board could achieve many of the same positive results as would be sought through formal regulation. Congress anticipated that in exercising these powers, the Board would help ensure that DOE is safely managing the production, use, and storage of defense nuclear materials and attendant nuclear waste streams, while providing reasonable assurance that there is no undue risk to workers and the public and

that there is adequate protection of the environment. Congress was aware that the safety policies and standards issued by DOE needed upgrading, and that operations by DOE and its contractors had in the past left extensive residual contamination in buildings and their environs.

Its enabling statute empowers the Board to conduct investigations, issue subpoenas, hold public hearings, gather information, conduct studies, establish reporting requirements for DOE, and take other actions in furtherance of its review responsibilities. These functions are ancillary to the accomplishment of the Board's primary function—assisting DOE in identifying health and safety problems at defense nuclear facilities so they can be corrected. The law requires DOE and its contractors at defense nuclear facilities to give the Board their full cooperation.

The Board's review and advisory responsibilities apply throughout the life cycle of DOE's defense nuclear facilities, covering design, construction, operation, and decommissioning. The law explicitly directs the Board to review and evaluate the content and implementation of health and safety standards, including DOE's orders, rules, and other safety directives pertaining to the design, construction, operation, and decommissioning of defense nuclear facilities. The Board is also required to recommend to the Secretary of Energy any specific measures, such as changes in the content and implementation of those standards, that it believes should be adopted to ensure that public health and safety are adequately protected. In addition, the statute mandates that the Board review the design of new defense nuclear facilities and modifications to older facilities before the start of construction, and recommend any changes found necessary.

The Board recognizes that DOE must perform its essential national defense work without unwarranted delay. The Board has been able to keep its safety reviews synchronized with DOE activities by timely assignment of its staff to monitor and review work involving design, construction, or preparations for readiness to operate. The technical staffs of the Board and of DOE and its contractors have frequently resolved technical issues that arose during these reviews without the need for formal action-forcing measures by the Board. If the Board identifies safety issues that must be resolved before work may proceed, it can, and frequently does, formally define those issues and recommend that they be resolved by DOE. In the case of operations at the Rocky Flats Environmental Technology Site (RFETS), Congress required that before plutonium operations are resumed in specified buildings, the Board must determine to its satisfaction that DOE's response to specific recommendations by the Board adequately protects public health and safety.

The Board communicates to DOE the most significant deficiencies it identifies using the formal recommendation process set forth in the Board's enabling statute. These recommendations describe perceived weaknesses and provide guidance on what the Board considers to be advisable solutions. In response to the recommendations, the Secretary submits to the Board implementation plans that address the issues identified. The Board monitors the progress of each step in implementation of the mutually agreed-upon plans until the planned actions are completed. To date, the Board has issued 36 sets of recommendations containing 166 specific recommendations; many of these are discussed in detail later in this report.

In addition to reviewing the basic elements and structure of DOE's safety management program, the Board gives priority attention to those facilities and activities that present the greatest safety risks—the elements of the nuclear weapons complex devoted to (1) the stewardship, maintenance, and surveillance of nuclear weapons; (2) the stabilization of hazardous remnants of weapons production; and (3) the storage of strategic and highly radioactive materials. For those facilities and operations that present significant hazards, the Board urged DOE in Recommendation 95-2 to institutionalize a safety management program that makes work planning and safety planning an integrated process, and results in well-documented authorization bases and clearly defined safety measures. Such measures are to be tailored to the specifics of the work being performed and designed to protect the public, workers, and the environment. Adoption of such programs will result in (1) definition of systems and components important to safety, (2) establishment of technical specifications that define limiting conditions of operation and other safety measures, and (3) development of the infrastructure needed to support safe operations and maintenance.

DOE has endorsed the concept of Integrated Safety Management; issued a policy statement, DOE P450.4, *Safety Management System Policy,* to so advise its contractors; and modified its procurement regulations (Department of Energy Acquisition Regulations [DEAR], contained in Title 10 of the Code of Federal Regulations, Part 900, *et seq*.) to make such a system mandatory for future procurements. DOE has also modified its existing Management and Operating (M&O) contracts and Management and Integration (M&I) contracts to make Integrated Safety Management a requirement. Improvements in safety management have already been made for a number of facilities and operations. The initial thrust of the effort to upgrade safety management, in response to Recommendation 95-2, *Safety Management*, is to target a number of high-risk facilities for priority attention to upgrading of safety management. The Board's goal is for DOE to implement Integrated Safety Management programs throughout the defense nuclear complex, and to ensure that they are tailored to the hazards of the diverse activities conducted in the complex.

In the area of decommissioning of defense nuclear facilities, the Board has been paying particular attention to facilities that still contain substantial inventories of nuclear material requiring stabilization and that must undergo deactivation for safe transition to final cleanup and environmental restoration. Under the Atomic Energy Act, DOE manages the final stages of decommissioning, often in cooperation with federal Environmental Protection Agency (EPA) officials and their state counterparts, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). The Board is cooperating with DOE, EPA, and the states to bring about effective decommissioning programs when CERCLA and RCRA regulation by EPA and the states is involved. The cooperative agreements made by the Board with the State of Colorado, EPA, and DOE with respect to activities at RFETS are now being implemented.

Each year the Board must report to Congress concerning its oversight activities, its recommendations to the Secretary of Energy, and safety improvements achieved at defense

nuclear facilities as a result of its activities. This Annual Report responds to that statutory requirement.

1.2 OVERVIEW OF 1997 ACTIVITIES

1.2.1 Complex-Wide Health and Safety Issues

To improve safety throughout the DOE nuclear weapons complex, the Board identifies safety issues that have applicability across many, if not all, of the defense nuclear facilities under its jurisdiction. The Board's activities of this nature address both the program coordination and technical guidance provided by DOE-Headquarters and the implementation of such programs or actions to correct deficiencies at individual sites. In summary, in 1997 the Board focused on the following:

- Development of DOE-Headquarters guidance for the development and implementation of Integrated Safety Management programs.

- Implementation of Integrated Safety Management programs at high-priority facilities, including those at the Hanford Site, Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), the Pantex Plant, the Savannah River Site (SRS), RFETS, and the Oak Ridge Site (the Y-12 Plant and defense-related areas of Oak Ridge National Laboratory [ORNL]).

- Review of DOE's Directives System documents, including Order 430.1 on Life Cycle Asset Management, Order 420.1 on Facility Safety, Order 435.1 on Radioactive Waste Management, and Order 251.1 on the Directives System.

- Improvement in the technical competence of DOE's safety management personnel, including DOE's efforts to maintain excepted service hiring authority and to sustain a technically qualified workforce in the face of budget reductions and potential reductions in force.

- Identification and elimination of suspect and counterfeit parts.

1.2.2 Emphasis on Ensuring Safety of Operations Involving Nuclear Weapons and Components

In 1997, the Board continued its emphasis on ensuring the safety of that part of the enduring nuclear weapons stockpile which resides at DOE sites, particularly with regard to activities in support of stockpile management and stewardship. The Board also placed considerable emphasis on ensuring that the dismantlement of retired nuclear weapons is completed safely.

A major portion of the Board's actions in these areas concerned seven sites: the Pantex Plant, near Amarillo, Texas; the Y-12 Plant, in Oak Ridge, Tennessee; LANL, in Los Alamos, New Mexico; Sandia National Laboratories (SNL), in Albuquerque, New Mexico, and Livermore, California; LLNL, in Livermore, California; SRS, near Aiken, South Carolina; and the Nevada Test Site (NTS). The following list of examples is representative of the impact the Board has had on safety at these sites during the past year.

- Board Recommendation 93-1, *Standards Utilization in the Nuclear Weapons Complex*, has resulted in DOE's developing the Seamless Safety (SS-21) process. During 1997, this process was used to dismantle all B61 Mods 2 and 5 nuclear bombs safely and to begin dismantlement of W69 nuclear warheads.

- The Board and its staff identified and brought to DOE's attention safety issues that would have significantly impacted the safe resumption of enriched uranium operations at the Y-12 Plant. For example, the Board and its staff found that explicit safety controls needed to prevent specific types of accidents were either not in place or not reliable.

- The Board was instrumental in improving the safety of the conduct of a special evaluation of nuclear weapons at Pantex. For example, the Board and its staff helped identify the parameters of interest during radiography of a weapon (namely dose rate, not total dose) and helped DOE identify needed safety controls on spin-testing of nuclear warheads.

- The Board helped identify and sensitize DOE to systemic safety issues with the operating culture of LANL's Chemistry and Metallurgy Research (CMR) facility. The laboratory subsequently chose to suspend operations at CMR until it and DOE make substantial safety improvements in work planning and work control.

- Continuing pressure and reviews by the Board and its staff led DOE to resolve safety issues pertaining to the storage of tritium at SRS, including installation of robust storage containers and reduction of fire hazards.

- The Board's Integrated Safety Management concept was successfully used by DOE in completing the first two subcritical experiments at NTS.

- The Board and its staff identified issues with the safety management system for Building 332 at LLNL that had not been captured during DOE reviews, and worked with DOE to develop a plan that, if executed, should resolve these issues and allow safe resumption of activities in the building.

- The Board analyzed issues surrounding the safe storage of plutonium pits at the Pantex Plant in its comprehensive technical report *Review of the Safety of Storing*

Plutonium Pits at the Pantex Plant (DNFSB/TECH-18). A series of consultations with DOE resulted in DOE's developing an integrated, systems-based plan for resolving the issues.

- The Board and its staff worked with DOE to prepare for safe startup of the Device Assembly Facility at NTS. When this facility is in operation, it is expected to provide NTS with its first modern facility for operations involving collocated high explosives and nuclear materials.

- Improved conduct of operations was implemented at the Pantex Plant, the Y-12 Plant, and at the weapons laboratories.

- Review of design and construction projects took place, including the Capability Maintenance and Improvement Project at LANL, the Actinide Packaging and Storage Facility at SRS, the Tritium Production Operations at SRS, and the Spent Nuclear Fuel Project at the Hanford Site.

Later sections of this report provide more details on these topics.

1.2.3 Hazardous Remnants of Weapons Production

In 1997, the Board continued to pressure DOE to move ahead expeditiously with its program for stabilizing the hazardous remnants of nuclear weapons production. Activities were pursued primarily at three sites: RFETS, SRS, and the Hanford Site. The following are examples of important DOE activities in which the Board has had a significant impact in improving safety:

- Safe stabilization of plutonium solutions at RFETS, reducing the site-wide inventory of such solutions to material held up in pipes and the bottom of tanks

- Safe startup of stabilization of plutonium salt residues at RFETS

- Completion of a number of upgrades to the structure, systems, and components in Building 371 at RFETS, and establishment of the authorization basis[1] for this building, which will play an increasingly important role in cleanup of the site

- Safe resumption of operations in H-Canyon at SRS to stabilize deteriorating spent nuclear fuel

[1] The authorization basis is the set of those aspects of the facility design basis and operating requirements relied on by DOE to authorize operations. See DNFSB/TECH-5, *Fundamentals for Understanding Standards-Based Safety Management of Department of Energy Defense Nuclear Facilities* , and DNFSB/TECH-6, *Safety Management and Conduct of Operations at the Department of Energy's Defense Nuclear Facilities* .

- Safe startup of the bagless transfer system for packaging plutonium metal in the FB-Line at SRS

- Successful implementation of systems engineering at the Tank Waste Remediation System at the Hanford Site

- Safe removal of highly radioactive uranium-233 (U-233) deposits in process lines in the Molten Salt Reactor Experiment at Oak Ridge National Laboratory.

Details of these examples and other related activities are presented in Section 4.

1.2.4 Development of the Board's Strategic Plan under the Government Performance and Results Act of 1993

The Government Performance and Results Act of 1993 (GPRA) requires each agency to prepare and submit a strategic plan establishing long-term programmatic, policy, and management goals. The Board was particularly well prepared for this initiative, having included substantial strategic planning information in recent Annual Reports to Congress. The Board's Strategic Plan was submitted to the Office of Management and Budget as part of the Board's fiscal year (FY) 1999 Budget Request. The present Annual Report is structured to be consistent with the Board's Strategic Plan.

Agencies are also required to develop performance plans for achievement of their strategic plan's goals and objectives. A report assessing progress against that performance plan is due at the end of FY 1999.

The Board's Strategic Plan is based on the unique circumstances surrounding the statutory establishment of the Board in 1988:

- The national security of the United States requires that DOE continue to maintain and operate the facilities that support the nuclear stockpile.

- Maintaining the nuclear stockpile requires operations with nuclear materials and high explosives that could endanger DOE workers, the public, and the environment.

As described in its Strategic Plan, the Board executes its safety oversight responsibility according to the following principles:

- The primary responsibility for ensuring protection of the health and safety of the public and workers and protection of the environment rests with DOE line managers and extends in an unbroken chain from the Secretary of Energy to the workers at DOE sites.

- The Board has unique authority under its enabling statute to elicit a response from DOE on safety issues, and thus the Board influences the actions of DOE's line management to the extent needed to achieve safety objectives. The Board is able to interact concurrently with different levels of management in DOE and its contractors, and in doing so to cut through bureaucratic levels to induce timely action.

- Effective safety management demands that safety expectations be clearly defined and tailored to specific hazards at all levels—site, facility, and activity.

- Technical expertise is required to define controls commensurate with identified hazards and to ensure compliance.

- The Board's safety oversight activities will be prioritized by perceived risks to the public, workers, and the environment. Key indicators are the types and quantities of nuclear material at risk and the processes and operations involved.

- The Board's safety oversight responsibilities for defense nuclear facilities will be accomplished in full cooperation with other agencies, such as individual states and EPA, having statutory responsibility for regulating final cleanup, demolition, and environmental restoration activities at some defense nuclear facilities, in compliance with responsibilities mandated by the Atomic Energy Act of 1954, as amended, and federal environmental laws, including CERCLA and RCRA.

The Board's Strategic Plan establishes a framework for making management decisions and describes the nature of the Board's work within three focus areas:

- Complex-wide health and safety issues

- Management and stewardship of the nation's stockpile and nuclear weapons components

- Hazardous remnants of weapons production

These strategic areas are those emphasized in the Board's actions to assist the Secretary of Energy in ensuring the safety of defense nuclear facilities. Each of these areas of concentration has a set of objectives, action plans, and measurements.

1.2.5 Board Recommendations in 1997

During 1997, the Board issued two formal recommendations: Recommendation 97-1, *Uranium-233 Within the DOE Complex*; and Recommendation 97-2, *Continuation of Criticality Safety at Defense Nuclear Facilities in the Department of Energy Complex*. These recommendations included a combined total of 17 subrecommendations.

Recommendation 97-1

The Board's Strategic Plan contains an objective to verify the safety of surplus uranium, plutonium, and other materials and remnants of the nuclear weapons complex. U-233 is a man-made isotope of uranium whose decay products and contaminating isotopes are highly radioactive, and that has a specific alpha particle activity approaching that of weapons-grade plutonium. It is stored at a number of sites, most of it at ORNL and the Idaho National Engineering and Environmental Laboratory (INEEL).

Because most of the U-233 at these sites has not been inspected for many years, there is uncertainty as to the safety of its current storage condition. Moreover, because of the high radiation dose associated with U-233, material handling or even superficial examination is likely to be difficult, requiring protection from both alpha particles and gamma ray emissions. Since U-233 is a unique radiation hazard, its safe handling requires particular expertise and experience.

During 1997, the Board's staff reviewed this storage issue and presented results of that review in a technical report, DNFSB/TECH-13, *Uranium^{233} Storage Safety at the Department of Energy Facilities.* Based on the findings in this report, the Board issued Recommendation 97-1 on March 3, 1997, urging DOE to inventory this material complex-wide, plan for its ultimate disposition, and upgrade storage arrangements in the interim. The Secretary accepted Recommendation 97-1 on April 25, 1997, and provided an acceptable implementation plan in late September.

The Board accepted DOE's implementation plan in October, but questioned DOE's diffuse organizational structure for satisfying the commitments in the plan. The Board expressed its preference for a single project manager with sufficient responsibility and authority to work effectively across DOE's organizational lines, and with adequate budget control to execute the plan. This issue remains open and is to be subject to continued Board review during 1998.

Under the auspices of its Office of Environmental Management, DOE has initiated work in several areas of its 97-1 implementation plan, including (1) development of a new U-233 safe storage standard, (2) limited early assessments of U-233 items that have relatively low radiation dose rates, (3) assessments of alternatives for storing U-233 in Building 3019 at ORNL, (4) development of system-level requirements for the long-term storage of U-233, and (5) assessment of the technical capability for maintaining U-233 expertise within the DOE complex. Several deliverables associated with the above actions are scheduled to be provided to the Board by the spring of 1998. These deliverables include such major products as site assessment reports, which detail the risk of U-233 at the individual sites, and a systems requirements document, which provides the major functions and requirements of the overall project.

Recommendation 97-2

Recommendation 97-2 was issued to build upon a prior Recommendation, 93-2, *The Need for Critical Experiment Capability*. In 1993, the Board became aware of DOE's impending closure of the last nuclear criticality experimental facility in the country, located at LANL. That closure would have ended the hands-on education of new generations of scientists and engineers in the properties and behavior of fissionable material that presents nuclear criticality issues. Because expertise in criticality safety is likely to be needed as long as fissionable material is used and stored, the Board viewed the threatened end of experimental criticality studies as inimical to criticality safety in future DOE activities. Consequently, the Board issued Recommendation 93-2, strongly advising against DOE's proposed action.

As a result of Recommendation 93-2, DOE reconsidered its closure plan and opted instead to reinvigorate the program of experimentation in nuclear criticality. DOE has made substantial progress in coordination and implementation of its critical experiments program. Funding for the program has stabilized, albeit at a low level, and work has been initiated on a list of priority experiments. Several problems with regard to criticality control still remain in the DOE complex. For example, (1) the number of criticality safety professionals with first-hand experimental criticality experience remains small; (2) currently, many criticality safety practitioners have limited practical experience in fissile material operations—skills that are necessary to identify or assist operating personnel in identifying credible upset conditions applicable to operations; and (3) experimental data and guidance pertinent to criticality safety are needed to permit the analysis of cleanup operations and the associated handling, storage, and shipping of fissionable material mixed with other material.

To build on the successes of Recommendation 93-2 and to address some of the continuing shortfalls, the Board issued Recommendation 97-2 in May 1997. In this latest recommendation, the Board (1) addressed the need for a more effective program for training and qualifying engineers responsible for criticality safety, and (2) stressed the importance of critical experiments both in the training of engineers and in the verification of criticality evaluations that define safety limits and controls in weapons-related activities, in chemical processes, and in handling operations involving radioactive waste.

Copies of the Federal Register Notices for Recommendations 97-1 and 97-2 are provided in Appendix A.

1.3 STATUTORY ASSIGNMENT TO REVIEW EXTERNAL REGULATION MATTERS

On November 18, 1997, the President signed into law the National Defense Authorization Act for FY 1998. This legislation requires the Board to make recommendations to Congress relative to external regulation of defense nuclear facilities by the Nuclear Regulatory Commission

(NRC), a matter that continues to be under consideration by DOE. The Board's Fifth Annual Report, dated February 1995, addresses many of the important issues included in Congress' recent directive. In its report in response to the FY 1998 Authorization Act, the Board intends to give those issues its careful attention, recognizing that adequate oversight of DOE's defense nuclear complex is essential to the nation's security and to public safety.

1.4 CHANGE IN BOARD MEMBERSHIP

On November 22, 1996, John W. Crawford, Jr., retired after 7 years of dedicated service on the Board. He was a charter member of the Board, having been sworn in to an initial term in 1989. In 1991, he was renominated by President George Bush and confirmed by the Senate for a full 5-year term. Mr. Crawford brought to the Board his comprehensive knowledge and experience in the engineering and construction of nuclear reactors used by the U.S. Navy and commercial electric utilities, acquired during 45 years of government service.

In his 7 years on the Board, Mr. Crawford served tirelessly to further the Board's goal of ensuring safety at DOE facilities. His strong interest in seeing that DOE develops and implements adequate safety standards contributed substantially to the Board's activities in carrying out its Congressional mandate in the standards area. Mr. Crawford also provided leadership in other areas important to developing a "safety culture" at DOE, including his strong advocacy of steps to improve the selection, training, and qualification of personnel, and his close attention to radiation protection issues.

On November 3, 1997, the Board welcomed Dr. John E. Mansfield as a new member. His appointment by President Clinton and confirmation by the Senate brings the Board back to its full complement of five members. Dr. Mansfield is a physicist with a broad background of service in both the legislative and executive branches of the federal government, as well as in the private sector. He brings to the Board his experience in nuclear science and risk assessment, nuclear weapons technology, and defense policy analysis. A copy of Dr. Mansfield's resume is provided in Appendix B to this report. His resume, as well as those of the other Board members, is also available on the Board's Internet Web page (www.dnfsb.gov).

1.5 ENHANCED COMMUNICATION

In its Second Annual Report to Congress, dated February 1992, the Board described its methods of performing independent oversight of defense nuclear facilities and its efforts to keep the public informed of its activities. This description has been expanded upon by the Board in its Strategic Plan, which as noted was submitted in accordance with the requirements of the Government Performance and Results Act of 1993 (see the Board's Internet Web page, www.dnfsb.gov).

During the past year, the Board has intensified its efforts to enhance communication with DOE. While the Board continues to use its formal statutory tools, such as recommendations, requests for reports, and investigations, it has increased the use of informal methods, consistent with the Board's Policy Statement No. 2. That Policy Statement outlines methods for informally resolving safety issues not serious enough to warrant a recommendation. These methods include Board letters transmitting safety concerns and observations, meetings between individual Board members and senior DOE officials, site visits, teleconferences, and open public meetings with DOE officials. Six Board public hearings were held in 1997, each of which involved substantive interchanges with senior DOE officials.

To remain better informed on DOE activities and initiatives, the Board has received regular briefings by the Secretary and senior secretarial officers. Information received by the Board in these briefings is helpful in understanding how much progress is being made on safety matters and in gauging DOE's commitment to achieving real progress. The Board has directed its staff to meet frequently with DOE counterparts to ensure, first, that DOE understands the Board's safety objectives and initiatives, and second, that senior members of the Board's staff are able to brief the Board on the status of safety issues and programs and on key safety questions. This increased level of informal interaction conserves federal resources by ensuring that DOE and the Board understand each other's positions in depth. This understanding, in turn, permits the Board to focus its recommendations, letters, requests for information, and public hearings on the most important issues to be resolved. It averts the waste of resources of both DOE and the Board on false starts and contention over easily resolved side-issues, and reduces time and money spent on paperwork inevitably connected with formal communications. In many cases, the simple exchange of ideas is sufficient to motivate DOE to take appropriate actions without the Board's having to make formal recommendations.

The Board remains committed to this policy of enhanced communication in the belief that in the end, safety is best served by spending federal dollars on real improvements at defense nuclear facilities. Informal communication and discussions with DOE in an open forum have proved to be powerful, cost-effective tools in advancing the Board's nuclear safety initiatives.

There are many other instances of the Board's policy of operating in this open fashion. For example, the Board often transmits to DOE trip reports prepared by the Board's staff, thereby sharing the staff's observations and findings. The Board also calls DOE's attention to important findings in these reports, such advisories often being sufficient to lead to responsive corrective action by DOE management.

Some trips by the Board's staff are driven by the need to evaluate a particular problem in the field. For example, a recent team visit to the Hanford Site to review the Spent Nuclear Fuel Project resulted in identification of numerous technical and management weaknesses. These observations were documented in a technical report, DNFSB/TECH-17, *Review of the Hanford Spent Nuclear Fuel Project*, which the Board transmitted to DOE soon after the visit was completed.

The Board's technical reports (identified by a DNFSB/TECH designation) are important vehicles for communicating the Board's safety philosophy and for sharing its expert views on highly complex technical issues. Four such reports[2] were the products of efforts by individual Board members. Apart from the Board recommendations they spawned, these reports have had significant influence on the manner in which DOE now conducts its safety management program. Similarly, technical reports produced by the Board's staff have served as valuable input to the Board's formal recommendations or have laid the foundation for further analysis by the Board and its staff.

As is clear from the foregoing, these informal methods of communication and the interactions they generate are frequently the impetus for substantive DOE corrective actions without recourse to a formal Board recommendation. Through these means, the Board exerts considerable influence on safety improvements at the sites while engaging DOE in a constructive and cooperative dialogue aimed at improving safety in DOE operations. Examples of achievements that were a direct result of the Board's enhanced communications aimed at improving nuclear safety include the following:

- Identification by DOE, the weapons design agencies, and the Pantex contractor of hazards of concern and appropriate controls for nuclear weapon activities involving radiography and dynamic balancing. These activities are now operating with significantly improved safety controls.

- Improvements in the method by which DOE selects which facility at Pantex will be used to conduct operations on different nuclear weapon systems. The improved process better matches the inherent hazard prevention and mitigation capabilities of a facility to the hazards of a specific weapon operation.

- Development and implementation by DOE and its contractor at the Y-12 Plant of corrective actions to ensure the adequacy of controls associated with the hazards of enriched uranium operations required to fulfill an important national mission. These corrective actions reduce the chance that systems required for safety would fail to perform a safety function when required.

- Continued improvement of the Nuclear Explosive Safety Study (NESS) process, used by DOE to ensure the safety of nuclear weapon operations—as clearly indicated by a much-improved NESS for the W69 dismantlement program.

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[2]DNFSB/TECH-5, *Fundamentals for Understanding Standards-Based Safety Management of Department of Energy Defense Nuclear Facilities* ; DNFSB/TECH-6, *Safety Management and Conduct of Operations at the Department of Energy's Defense Nuclear Facilities* ; DNFSB/TECH-10, *An Assessment Concerning Safety at Defense Nuclear Facilities: The DOE Technical Personnel Problem* ; and DNFSB/TECH-16, *Integrated Safety Management* .

- Transformation of the Plutonium Facility (TA-55) at LANL from a facility with relatively informal and inadequate control of its safety envelope to one that is a model of Integrated Safety Management, particularly work planning and work control, resulting in improved efficiency, productivity, and safety.

- Increased DOE focus on safe storage of plutonium pits at the Pantex Plant, to ensure that all pits will be stored in sealed containers with a dry noncorrosive environment, and that a logical safe storage program plan, improved storage conditions, and improved safety controls and surveillance practices are implemented.

- DOE development of an acceptable plan for utilization of the F-Canyon and the H-Canyon at SRS, an important step toward achieving the safe, permanent disposition of radioactive residues from several DOE sites. The restart of H-Canyon for the purpose of stabilizing spent nuclear fuel is a major milestone.

- Improvements in the lightning protection and electrical isolation systems for the bays and cells at Pantex to minimize the threat to nuclear explosive safety from a lightning strike.

- DOE agreement to revise Order 251.1, *Directives System*, to ensure that health and safety directives are not inadvertently allowed to expire because of "sunset" provisions; that the technical content of the directives affecting health and safety is controlled by the DOE organization having the technical expertise; and that health and safety considerations are given appropriate weight in cost evaluations of proposed new or revised directives.

- At the Hanford Waste Encapsulation and Storage Facility, design of an improved overpack container (Type W), which provides better confinement of the highly radioactive cesium chloride capsules, each containing about 50,000 curies of cesium-137.

- Improvement of the process for tracking and resolving open safety issues at SRS so that serious safety issues, such as the accumulation of flammable gases in tank waste solids, will no longer be studied for extended periods without entering the formal Unreviewed Safety Question Determination process.

- Refinement of safety analyses to better define the risk of operating the High-Level Waste Evaporators at SRS, resulting in additional controls to improve the safety of evaporator operation. These controls included reducing the amount of time required to isolate high-pressure steam in a steam tube rupture and providing for isolation of building ventilation to reduce accident consequences.

- Significant improvement in the quality of LANL's hazard and risk analyses and in the identification of controls for hydrodynamics testing conducted as part of stockpile stewardship, leading to implementation of more rigorous safety-related controls than were previously envisioned.

- Improvement of the emergency preparedness planning for potential accidents at a complex at NTS that is used to conduct subcritical experiments as part of nuclear weapons stockpile stewardship.

- Mitigation of the fire hazard of tritium stored in reservoirs within a vault at SRS by removing combustibles, isolating the vault air system from the adjoining building, and fabricating robust reservoir containers resistant to a collapse of the vault roof.

- Significant improvement in safety analyses and supporting documentation to provide a stronger basis for acceptance of the risk of operating the Environmental Conditioning Chambers used to test tritium reservoirs at SRS, including consideration of potential explosion accident scenarios.

- Intensified activities to improve criticality safety at the Plutonium Finishing Plant and to rework readiness plans.

- Reversal of an earlier decision to eliminate routine ventilation requirements from the authorization basis for high-level waste tanks at SRS and upgrading of accident analysis.

- At SRS, abandonment of plans to cut overhead costs by moving "low-assay" plutonium-238 materials to an unsuitable facility (Building 235-F).

- DOE continuance of funding for the 50-year study of the health effects of plutonium uptake by workers, providing information vital to putting the risks of plutonium exposure into perspective.

- At the Pacific Northwest National Laboratory (PNNL), initiation of a 3-year Operational Improvement Program that fundamentally revises the way PNNL manages its operations, making environment, safety, and health issues an integral part of the conduct of research.

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2. COMPLEX-WIDE HEALTH AND SAFETY ISSUES

2.1 ESTABLISHMENT OF A STANDARDS-BASED SAFETY MANAGEMENT PROGRAM

The Board's enabling statute includes, among other mandates, direction for the Board to review and evaluate the content and implementation of the standards related to the design, construction, operation, and decommissioning of DOE's defense nuclear facilities, and to recommend to the Secretary of Energy those specific measures that should be adopted to ensure that public health and safety are adequately protected. The enabling statute also directs the Board to review design and construction projects for new DOE defense nuclear facilities, as well as significant modifications to these facilities, with the intent that the design and construction of new facilities would meet current safety standards.

Congress intended that the Board would be instrumental in helping DOE develop appropriate and operationally meaningful safety standards and in ensuring their incorporation into clear and consistent requirements for DOE management and contractors. Congress also intended that the Board would raise the technical competence of DOE to the level required to ensure that design, construction, operation, and decommissioning of defense nuclear facilities would be performed in an integrated manner that would provide adequate protection of the health and safety of workers and the public.

In the past year, the Board has maintained its momentum toward accomplishing these Congressional mandates. The initial direction had been set by earlier recommendations issued by the Board, in particular:

- Recommendation 90-2, which requested that DOE identify its safety orders, evaluate their adequacy, and determine the state of their implementation.

- Recommendation 91-1, which identified the need for strengthening the standards and the capability for their development and implementation.

- Recommendation 93-1, which called on DOE to examine its orders applicable to assembly, disassembly, and testing of nuclear weapons, to ensure effectiveness comparable to that in other nuclear areas.

- Recommendation 94-5, which addressed the need to retain effectiveness in new orders and in rules replacing orders.

- Recommendation 95-2, which urged DOE to institutionalize a process for Integrated Safety Management (ISM) at defense nuclear sites.

Appropriate application of the methods recommended in 95-2 would accomplish the results sought by the Congressional mandate. Part of the Board's activity in past years has been directed to working with DOE to institute the methods advocated in Recommendation 95-2 at ten defense nuclear facilities that stand first in order of priority. Results have been mixed, with outstanding success at some of DOE's facilities and more pedestrian efforts at others. These activities and results are presented in detail in later sections of this report, particularly in Section 2.2, which describes the year's progress in development of Integrated Safety Management at defense nuclear facilities and the related actions by the Board and its staff.

The remainder of the work involving DOE standards and orders has been principally to ensure their adequacy and that of the associated documents that provide key input to Integrated Safety Management. This work is described in Section 2.3.

2.2 INTEGRATED SAFETY MANAGEMENT PROGRAMS

During 1997, the Board began to see the fruits of previous years' labors to foster the development of technically sound ISM programs across the defense nuclear complex. These results would not have been possible as recently as a year ago. DOE has taken the important first steps, and although there is still some variance in the progress achieved at individual sites and facilities, the Board is heartened to note overall improvement in this crucial subject area. It is appropriate to recapitulate here some of the more significant milestones.

In October 1995, the Board issued Recommendation 95-2, *Safety Management*. Actions during 1995 and 1996 in accordance with this recommendation were the basis for the Board's progress in this area in 1997.

In Recommendation 95-2, the Board stressed five lines of action:

1. Institutionalize the ISM process, so that every major defense nuclear activity involving hazardous materials is planned and executed in a manner that ensures that environment, safety, and health objectives are achieved. A major objective of this effort was to secure a Secretarial imprimatur for ISM that would foster stability and consistency in the regulatory framework and its administration.

2. Require that all highly hazardous nuclear work be done under Integrated Safety Management Systems (ISMSs). The controls derived from these systems are to be graded in rigor according to the risks associated with the activity. This line of action had goals of achieving the integration of work planning and safety planning (the key to the entire enterprise), requiring that DOE and its contractors develop mutually agreed-upon safety measures as conditions prerequisite to the performance of work, and ensuring that control measures would be appropriately tailored to the specifics of the hazards.

3. Apply the ISM concept to all defense nuclear facilities and activities, with initial focus on a prioritized list in order to address the facilities and activities of highest hazard and importance first, to benefit from lessons learned during this initial implementation, to facilitate transition to widespread implementation, and to allow the "institutionalizing" process to mature.

4. Promulgate requirements and guidance for ISM aimed at defining expectations and establishing responsibilities and authorities.

5. Acquire/train the expertise needed within DOE to implement ISM in order to ensure the availability of the technical resources needed to direct and administer the programs.

In April 1996, Secretary of Energy, Hazel R. O'Leary, submitted an implementation plan for Recommendation 95-2 that the Board reviewed and found to be acceptable. DOE established a Safety Management Integration Team (SMIT) to coordinate for the Office of the Secretary the various lines of action committed to under the plan, to foster its implementation throughout DOE, and to provide the principal interface with the Board on the program.

In October 1996, Secretary O'Leary issued Policy Notice P450.4, *Safety Management System Policy*, which affirmed DOE's commitment to the ISM concept and set forth the principles upon which such safety management programs should be based.

The above account provides the setting in which progress during 1997 is to be viewed.

2.2.1 Board's ISM Implementation Review in 1997

The momentum of actions in 1996 for achieving Recommendation 95-2 commitments was maintained through the change in DOE's Secretarial leadership. Secretary Peña endorsed the basic tenets of the ISM concept, and instructed the DOE staff to move forward as committed. The Board is encouraged by this reaffirmation of DOE's commitment to what the Board believes is a fundamentally sound approach to safety management that is readily adaptable to the diversity of activities performed by DOE's contractors.

In 1997, DOE expanded upon its 1996 Safety Management Policy, promulgated in response to Board Recommendation 95-2, by issuing regulations that mandate the contractual application of ISM; the drafting of guidance on ISM development; and the assignment of functions, responsibilities, and authorities for safety management. The Board and its staff tracked the preparation of these instructions, and this interaction contributed to their shaping. Progress was also made in the priority implementation of ISM at the defense nuclear facilities that were highlighted as highest priority in DOE's implementation plan for Recommendation 95-2.

The Board communicated frequently during 1997 with DOE's Secretarial Officers regarding the ISM implementation program. The Board was briefed regularly by the SMIT on implementation progress, or lack thereof, and made the status of ISM implementation a regular item of briefings by DOE's field managers and contractor managers during the Board's visits to defense nuclear facility sites. Further, the Board dedicated specific staff members to interface with the SMIT and other key DOE and contractor safety managers in the interest of advancing this program. Implementation of Recommendation 95-2, which is central to DOE's nuclear safety management and the Board's approach to safety oversight, has been and is likely to continue to be a major focus of the Board's attention and action-forcing activities directed toward enhanced safety at defense nuclear facilities.

In June 1997, the Board issued DNFSB/TECH-16, *Integrated Safety Management*. This technical report was issued to inform those not familiar with ISM concepts, as well as to provide guidance to those working to make ISM a reality. The report has been well received; as evidence of the interest shown, the report has been accessed from the Board's Internet site more than 600 times to date, and more than 600 printed copies have been requested and distributed.

2.2.2 Institutional Development/Implementation of ISM

DOE Acquisition Regulations (DEAR) Clause/Acquisition Letter

A major purpose of the Board's Recommendation 95-2 was to institutionalize the concept and practice of ISM at defense nuclear facilities. Recognizing that these facilities are operated by DOE through contractors, the recommendation stated, in part, "The requirement for conformance [with safety management programs] should be made a contract term." DOE accepted this part of the recommendation through an implementation plan commitment to insert appropriate terms in the Department of Energy Acquisition Regulations (DEAR).

In June 1997, DOE published a final rule (62 FR 34842) that, among other things, included two DEAR clauses in fulfillment of the implementation plan commitment. These clauses are *Integration of Environment, Safety and Health into Work Planning and Execution,* 10 CFR 952.5204-13, and *Laws, Regulations, and DOE Directives,* 10 CFR 970.52040-78. An Acquisition Letter was sent to DOE's contracting officers in September 1997, instructing them to insert these clauses in contracts no later than the end of 1997. The Board has been able to confirm that some contracts, but not all, have been modified to incorporate these key provisions.

Key features of these clauses are requirements that contractors for major acquisitions provide for DOE approval (1) a list of the general DOE requirements that apply to the contracted work, and (2) a description of the ISM system they commit to deploy.

During 1998, the Board plans to review contracts regularly in order to ensure that these clauses are incorporated into contracts and implemented so as to institutionalize ISM in DOE's defense nuclear complex.

ISM Guide/Tailoring Report

DOE's implementation plan for Recommendation 95-2 committed to the issuance of ISM guidance on how the 1996 Safety Management Policy should be implemented throughout DOE and the defense nuclear contractors. During 1997, the Board worked extensively with DOE, through reviews of several draft versions, to steer the guidance that was ultimately issued toward an effective and comprehensive product. The intent is for DOE's ISM guidance to be continually updated as experience with ISM implementation at priority facilities is gained.

DOE's implementation plan for Recommendation 95-2 also contains a commitment to develop explicit guidance on tailoring safety requirements according to the work and associated hazards. To address this commitment, DOE's Department Standards Committee chartered a group that ultimately developed a report on tailoring. The presentation on tailoring that was included in DOE's *Safety Management System Guide* was derived from this report.

The Board intends to continue to track and provide technical input to the development of DOE's guidance on ISM as it continues to evolve throughout 1998. A primary objective of this effort is to ensure that relevant experience gained from ISM implementation at the priority facilities is incorporated into future Guide revisions.

Review of Progress in Development of Functions, Responsibilities, and Authorities Manual (FRAM)

DOE has been undergoing a major reorganization of its managerial process during the past several years. Throughout this period, poor definition of the responsibilities and authorities of DOE staff members has been a weakness affecting DOE's ability to manage its safety responsibilities.

From its inception, the Board has placed substantial emphasis on the need for DOE to establish clear definitions of roles and responsibilities for nuclear safety. DOE attempts to develop a FRAM during 1994–1996 were unsuccessful, as organizational changes outpaced successive drafts of the FRAM. In late 1996, DOE concluded that the FRAM needed to be split into a series of documents, including a corporate-level FRAM (Level 1 FRAM) and subtier documents (Level 2 FRAMs) for each of the Headquarters Program Secretarial Offices and for each of the DOE Operations Offices. DOE's decision to fragment the FRAM document into an overlying Level 1 FRAM and a number of Level 2 FRAMs introduced a great deal of redundancy into the description of the system.

Revised FRAMs were delivered to the Board for review in July 1997. DOE indicated to the Board that these documents are intended to capture the way DOE is presently organized to discharge its safety responsibilities, not necessarily the way DOE directives require DOE to function. In a letter to DOE in October 1997, the Board cautioned that differences between the FRAMs and the directives need to be identified and resolved quickly.

The Board's October 1997 letter on the FRAMs also questioned the utility of this voluminous set of documents and the effectiveness of a safety management program whose definition requires so much documentation. Additionally, the Board emphasized some of the broader issues involved in defining safety responsibilities:

- Under the Atomic Energy Act, ultimate responsibility for the safety of DOE's activities rests with the Secretary of Energy. If this responsibility is to be delegated to the Deputy Secretary or to the Under Secretary (the latter is the choice stated in the FRAM), the Board believes certain high-level safety management functions should accompany that delegation.

- Every senior individual within DOE who is assigned safety management responsibilities should be able to discern from the FRAM what these responsibilities are without ambiguity. As one possibility, the Board suggested that some form of computerized indexing of key functions and responsibilities could achieve this end.

- In every large organization, authorities and responsibilities flow downward through the administrative structure by a process of delegation until they arrive at some individual or unit assigned the job of providing a particular product. An important function of a document such as the FRAM is clarifying where that assignment rests with respect to each type of product. The Board noted that the FRAM can accomplish its purpose only if it unambiguously informs the reader where each assignment of functional responsibility rests.

The Board intends to continue its interaction with DOE to ensure that DOE's line managers clearly understand their safety responsibilities. In October 1997, DOE issued a revised Level 1 FRAM and was projecting the next issuance of the Level 2 FRAMs in early 1998. The new Administration at DOE has committed to provide the Board with updates of the FRAM as organizational safety assignments become better defined.

Reporting Requirement on Contract Requirements, Enforcement, and Authorization Protocols

In a September 1997 letter to Secretary Peña, the Board requested that DOE provide answers to a list of questions in preparation for a public hearing on Recommendation 95-2 that the Board had scheduled for October. These questions covered the following major topics: contracting policy and practices, DOE review and approval of safety control measures and protocols, approved authorization agreements, and contract violations and remedies.

DOE responded to these questions in advance of the hearing, allowing the Board time to review the answers and formulate specific topics for public discussion. The Board's review of the written responses yielded the following observations:

- There are no provisions in the contracting process for enforcing safety requirements parallel to the Price-Anderson enforcement scheme for rules. Each field office has its own procedures and philosophy on contract enforcement. While rules are enforced at the Headquarters level by the Office of Environment, Safety, and Health, contract terms are enforced by field office personnel who also deal with the contractor on a day-to-day basis.

- Some field offices seemed reluctant to conclude that a rule violation is a contract violation *per se*, even though a contractor is required by the DEAR clause to ". . . comply with the requirements of applicable Federal, State, and local laws and regulations (including DOE regulations), unless relief has been granted in writing by the appropriate regulatory agency."

- The government pays the cost of correcting contractor errors unless lack of good faith or willful misconduct is involved. On the other hand, it appears that field offices now have contract incentive terms allowing them to penalize noncompliance and reward good practices.

- None of the responses on Authorization Agreement violations indicated that such agreements are to be treated any differently from other contract terms. No response offered the concept that certain Authorization Agreement terms (such as Technical Safety Requirements) should receive special contract treatment.

In 1998, the Board intends to explore the following contract-related questions:

- Should DOE consider holding contractors accountable for additional costs attributable to violation of safety requirements?

- Where the Contracting Officer is not qualified in relevant technical areas, should DOE consider having a "Contract Safety Officer" who is technically trained and qualified to manage the safety elements of the contract?

- How should the Authorization Agreement be embedded in the contract?

Integration of Directives and Initiatives

DOE's implementation plan for Recommendation 95-2 contains an explicit internal management commitment to "identify and then establish a Department-wide process for reconciling and integrating existing directives and ongoing initiatives with the Safety Management System." The implementation plan stated that the SMIT would ensure that "each ongoing Department directive and ongoing initiative related to safety management will be evaluated to determine whether it is consistent with the Safety Management System, and whether it meshes appropriately with other directives and initiatives. If this evaluation concludes that an existing

directive or ongoing initiative is not consistent, a process will be undertaken to reconcile and integrate the directive or program in line with DOE's integrated safety management system." To date, efforts to address this commitment have not been effective. The Board intends to press this issue with Secretarial Officers and to track the SMIT's actions in 1998 in order to resolve existing inconsistencies between DOE's directives system and assigned responsibilities.

2.2.3 ISM Implementation at Priority Facilities

Status

DOE's implementation plan for Recommendation 95-2 notes that DOE needs to "prioritize its facilities and activities according to their hazard and importance." This prioritization is essential if the implementation of ISM throughout the defense nuclear complex is to have the greatest benefit. Based on these considerations, DOE developed an acceptable list of sites and facilities, having equal priority, for initial implementation of ISM:

- K-Basins and Tank Farms at the Hanford Site
- Superblock at Lawrence Livermore National Laboratory (LLNL)
- TA-55 and the Chemistry and Metallurgy Research (CMR) facility at LANL
- Cells and bays at the Pantex Plant
- Canyons at Savannah River Site (SRS)
- Buildings 371 and 771 at the Rocky Flats Environmental Technology Site (RFETS)
- The Y-12 Plant

DOE institutionalized its commitment to the pursuit of ISM throughout the complex, beyond its direct commitments to the Board, by means of a formal strategy element in the *Department of Energy Strategic Plan*. In this plan, DOE commits to "integrate and embed sound environment, safety, and health (ES&H) management practices into the performance of DOE's day-to-day work." DOE's plan explicitly states that DOE will "implement Integrated Safety Management Systems at DOE's ten priority facilities and in all major management and operations contracts in FY 1999." The ten priority facilities noted are those committed to in DOE's Recommendation 95-2 implementation plan.

DOE's complex-wide implementation of ISM by DOE is being pursued under two major parallel but complementary lines of action:

- Development of site-wide standards/requirements and associated institutional-level implementing procedures

- Facility/activity-specific safety control measures tailored to the hazards involved

Throughout 1997, the Board urged DOE to place primary attention on development and implementation of ISMSs at each of the priority facilities. These priority facility-specific ISMSs

may incorporate existing institutional-level safety management programs where they exist. However, it is the Board's expectation that the experience gained in development of a fully integrated system at each priority facility will ultimately drive the institutional ISMS in the core safety management functional areas where that institutional system is deficient. This will ensure that the full set of contract requirements is expeditiously implemented at the working level of the priority facility. For some priority facilities, an interim ISMS, consisting of existing manuals and codes of practice, plus compensatory measures for any missing functional area program components, will need to be developed initially; this interim ISMS will evolve as the identified gaps are filled with newly developed facility-specific or institutional-level safety management programs, where needed.

DOE developed and implemented a pilot process in 1997 whereby technically competent teams conduct on-site verification of the adequacy of a contractor's ISM program. The findings of the teams were presented in briefings to the Board. One line of inquiry (described by DOE as Phase I) addresses the set of implementing procedures that the contractor asserts are adequate, if followed, to ensure that all contract requirements will be met for all work. The second line of inquiry involves confirmation that the institutional implementing procedures have been applied, and facility/activity-specific safety measures are being used at the work level (i.e., Phase II). The Board and its staff have been closely monitoring DOE's progress in implementing and verifying ISMS implementation. The Board has held three public meetings on this topic, and all 1997 verification reviews have been observed by the Board's staff. In addition, DOE Headquarters and field personnel briefed the Board on a number of occasions about plans for developing and conducting the pilot facility-specific and institution-level ISMS verification process.

In general, the sites that have priority facilities made progress in 1997 on several fronts vital to ISMS institutionalization, though the progress has been uneven. Most of the sites have completed or are actively working to develop tailored requirements and sets of standards for inclusion in their operating contracts. The DEAR clause was incorporated in all but two of the contracts for sites with priority facilities. Phase I verification reviews of ISMS were initiated or completed at two sites, and scheduled for early 1998 for another. These institutionalization actions are necessary to make ISM the standard way of conducting operations within DOE's defense nuclear complex.

Key Board reviews in 1997 revealed, however, that expeditious implementation of interim ISMSs at some of the priority facilities is still lagging, although actions to institutionalize and verify ISMS at the site level progressed. While progress toward developing an institutional ISMS was being made at LLNL, significant deficiencies in hazard analysis, development and implementation of controls, feedback of experience, and improvement at the priority Superblock were identified. Similar problems were also revealed at LANL's CMR facility.

The Board remains committed to near-term implementation of the core functions of ISM at all operating defense nuclear facilities. The Board intends to have its staff work with Secretarial Officers and the SMIT in early 1998 to urge DOE line management to aggressively

determine and expedite the progress of ISMS implementation on the floor at the priority facilities. This expeditious implementation at the priority facilities needs to occur on a parallel path with the institutionalizing of ISM at the site level throughout the defense nuclear complex.

There also continue to be issues on two other fronts. First, there appears to be a widespread lack of appreciation of some of the key terms and concepts associated with DOE's review and approval of ISMSs, most notably (1) the key elements of the ISMS description required by the DEAR clause and (2) the prerequisites for declaring readiness for Phase I and Phase II verification reviews. The Board has highlighted these significant areas of confusion to the SMIT, which plans to develop and disseminate additional guidance in early 1998. Second, the Board has urged the SMIT to become much more proactive in leading and coordinating the field ISMS implementation, to ensure that the actions progress with efficiency and effectiveness. The SMIT has a vital role to play in ensuring that the lessons learned at one site, both positive and negative, are communicated throughout the complex in order to steepen the learning curve on implementation and verification of ISMS.

Issues and Path Forward on ISMS Implementation and Authorization Agreements at Remaining Priority Facilities

As noted above, a great deal of progress was made in 1997 toward achieving the ISM objectives of Board Recommendation 95-2. As with all major shifts in concept for management, issues can be expected to arise as theory is put into practice. The SMIT will need to work with DOE line management in order to ensure expeditious implementation of the ISM core functions at the priority facilities. The DOE approach to verifying the adequacy of institutional ISMSs must continue to evolve. The guidance on ISM must continue to improve and reflect the experience gained at the working level.

The Board intends to continue to work with DOE Secretarial Officers and the SMIT in 1998 to ensure that adequate corporate-level guidance and leadership are provided by DOE-Headquarters to support the field efforts at ISMS implementation. As noted above, it is clear that the SMIT needs to become more proactive in advising and guiding the field offices, to ensure that implementation of ISMS at the priority facilities stays on track to meet DOE's strategic goal and the intent of Recommendation 95-2. The Board will also track on-site implementation of ISMSs throughout the defense nuclear complex in 1998 and beyond.

2.2.4 Complex-Wide Implementation

During the past year, DOE has been working toward establishing more clearly its safety management framework in the form of directives and guidance documents, and training safety managers for both DOE and contractor organizations who are responsible for ISMS implementation. While considerable progress has been made, the pace of conversion to this upgraded approach has not been as rapid as the Board believes to be merited and achievable. In 1998, the Board intends to continue its pressure for an acceleration of this pace and to focus

attention on the facilities and activities representing the greatest potential for mishaps that could be harmful to the public, workers, and environment. To this end, in December 1997, the Board imposed on DOE a reporting requirement to establish the status of ISM for approximately 40 facilities beyond the ten priority facilities that are the focus of the Recommendation 95-2 implementation plan. The Board's objective is to work with DOE to develop a specific path forward to ensure that all hazardous activities performed in defense nuclear facilities are being done under safety controls tailored to the specifics of the hazards.

2.2.5 Provisions for Verifying ISM Implementation

Recommendation 95-2 urged DOE to take measures to ensure that DOE itself has or acquires the technical expertise needed to verify the adequacy of implementation of ISM programs. In responding to Recommendation 95-2, DOE committed to (1) establish a Core Technical Group of individuals with expertise in a variety of safety management and technical disciplines, (2) develop a slate of qualified ISM Verification Review Team members and leaders, and (3) develop training courses to ensure that individuals in line management throughout the complex have a consistent understanding of the principles and concepts of ISM.

The Board has observed DOE's establishment of a Department-wide Core Technical Group. A database listing of approximately 600 Core Technical Group members and their technical competencies is being used in fielding teams for ISM Verification Review; for other safety reviews, such as Operational Readiness Reviews; and for a wide range of other assistance in complex-wide development and review of ISMSs.

In response to Board concerns, Under Secretary Grumbly and the SMIT developed a protocol for ensuring that adequate technical expertise would be available for ISM Verification Review Teams, including team members and leaders. The protocol is intended to ensure the availability of proper team member expertise, knowledge, and training through selection controlled by heads of DOE Field Offices, with concurrence from DOE-Headquarters Secretarial Officers. Additionally, the protocol calls for ISM Verification Review Team leaders to be chosen from a select list approved by the Under Secretary.

The Board's staff participated in DOE's pilot development of training courses on ISM concepts. At the end of 1997, DOE was revising the courses based on lessons learned from the pilot development activities and revision of the ISM Guide. Revised course material should be available for instruction complex-wide in early 1998.

2.2.6 Evaluation of DOE's Feedback and Improvement Safety Management Function

Programs for gathering data and translating lessons learned, both good and bad, from experiences in the workplace are requisites for establishing and constantly improving good safety practices. Achieving these objectives without unduly burdening the contractors' work with excessive DOE reporting requirements and oversight is the challenge. Two independent studies

commissioned by DOE (the "Galvin Report" in 1995 and the Institute for Defense Analysis "120-Day Study" in 1997) identified the need for improvements to the DOE program of oversight and audits. One conclusion of both reports was that there was too much uncoordinated and redundant DOE oversight—in effect, micro-management.

In response to findings of the Galvin Report, DOE conducted a series of programs on oversight of national laboratories to determine whether an enhanced program of contractor self-assessment by the contractor, coupled with scaled-back oversight by DOE, might be more effective. The pilot programs at the national laboratories generally revealed that the programs of contractor self-assessment were less robust than would be needed to justify a more relaxed program of oversight and audit by DOE. However, the concept prevailed that enhanced and demonstrably effective self-assessment by contractors could eventually justify some relaxation of oversight by DOE. In 1997, DOE drafted a policy articulating DOE's proposed method for combining self-assessment by contractors and oversight of the contractors' safety management programs by DOE officials. This policy, DOE P 450.5, *Line Environment, Safety, and Health Oversight*, was reviewed by the Board at several stages of development.

In May 1997, a DOE workshop held in Denver, Colorado, on the subject of effective and integrated self-assessment by the contractors and oversight by DOE brought together the key federal and contractor participants in the development of DOE P 450.5. Representatives from other segments of the defense nuclear complex who had not originally participated in development of the policy also participated. As a result of inputs from the participants in this workshop, including a Board member and representatives of the Board's staff, an acceptable version of the policy was generated; it was issued in June 1997.

This policy clearly states that an effective contractor self-assessment program is a prerequisite to any diminishment of the current extent of DOE's oversight by line management. Even with such a contractor program in place, the policy clearly notes that oversight by DOE's line management must continue to consist of day-to-day operational awareness activities (conducted by Facility Representatives and subject matter experts), as well as periodic comprehensive reviews, not limited to but including confirmation of the effectiveness of the contractor's self-assessments. The final policy does not in any way limit the independent oversight appraisals conducted by DOE's Office of Environment, Safety, and Health (EH).

2.2.7 Assessment of DOE's Internal Independent Oversight Function

The independent Safety Management Evaluations conducted by EH represent a key element of the internal DOE feedback and improvement program. In 1997, the Deputy Assistant Secretary of Environment, Safety, and Health for Oversight (EH-2) briefed the Board regularly regarding the findings of these evaluations, which are conducted independently of line management. In addition, the Board's staff observed the Safety Management Evaluation of Sandia National Laboratories (SNL) that was conducted by EH-2 in mid-1997. The evaluation at SNL focused on application of guiding principles and core safety management functions identified

in DOE P 450.4, *Safety Management System Policy*. The scope of the evaluation included the implementation of DOE P 450.4 principles and functions at several SNL facilities.

Overall, the evaluation at SNL by EH-2 was conducted professionally by a team of technically competent individuals who wrote an evaluation report that cites positive attributes, as well as a number of weaknesses or opportunities for improvement. In particular, the evaluation found deficiencies in analysis of hazards and development of safety controls during work planning, improper authorization of work, and improper use of and adherence to procedures. The evaluation also found that internal feedback and improvement programs at both SNL and DOE needed to be strengthened. In general, the EH-2 evaluation confirmed many of the deficiencies identified by the Board in a February 1997 letter forwarding a staff trip report on the subject, as well as identifying additional issues.

The Board believes that EH-2 Safety Management Evaluations of this type provide targets of opportunity to effect improvements at DOE's defense nuclear facilities if the resulting observations are welcomed and acted on by DOE and contractor line management. In 1998, the Board intends to continue to monitor and evaluate responses by DOE and contractor line management to these EH-2 evaluations, and the implementation and effectiveness of corrective actions.

The Board intends to continue its review of this important core function of ISM in 1998 and beyond, including continued evaluation of DOE's guidance and requirements and of the effectiveness of the implementation of feedback and improvement programs at defense nuclear facilities. The potential benefits from improvements in this area are profound.

2.3 REVIEW AND EVALUATION OF DOE DIRECTIVES AND RELATED DOCUMENTS

The Board's enabling statute, 42 U.S.C. §2286 *et seq*., assigns to it responsibility for review and evaluation of "the content and implementation of the standards relating to the design, construction, operation, and decommissioning of defense nuclear facilities of DOE (including all applicable DOE orders, regulations, and requirements) at each DOE defense nuclear facility." These requirements and guidance are key inputs in the development and implementation of ISM programs at DOE facilities and sites throughout the DOE complex. Therefore, the Board's reviews to determine the technical adequacy of new or revised standards ensure that requirements and guidance in these documents are sufficient to adequately protect the health and safety of workers and the public.

In meeting this mandate during 1996 and 1997, the Board reviewed numerous new safety orders and rules that were produced as a result of DOE's Order/Requirement Reduction and Streamlining effort to revise, improve, and upgrade many of its administrative, procurement, and technical requirements. The Board's staff conducted extensive reviews during this streamlining

process to ensure that the nuclear safety requirements in the proposed new DOE orders and rules adequately addressed the corresponding requirements in the existing orders being revised or replaced, or that deficiencies were identified for resolution. As part of these reviews, the Board held four public meetings in which representatives of DOE participated.

Only six of the proposed new safety orders in place at the end of 1996 were complete and judged to be adequate; i.e., they appeared to be technically sound, and retained the essential elements of their predecessors. Despite the technical adequacy of these six orders, however, DOE still had policy and legal questions to answer regarding provisions for granting deviations from requirements. At the Board's public meeting on this topic, in December 1996, DOE concurred with the Board's evaluations of new orders and proposed an action plan for making needed changes. Some issues related to rules remained unresolved at that time.

At the outset of DOE's initiative to streamline its Directive System, DOE informed the Board that it intended to replace older safety orders with new orders and, in some cases, regulations promulgated pursuant to the Atomic Energy Act, as amended, and the Administrative Procedures Act. However, existing safety requirements contained in contracts remain legally in effect until such contracts are amended to incorporate revised order requirements, or regulations are promulgated which supersede the contractual requirements.

During 1997, the Board's staff worked closely and cooperatively with DOE toward closure of open items that carried over from 1996, and continued its review of other new or revised documents in the DOE Directives System. By the end of 1997, all outstanding issues from the December 1996 public meeting had been resolved, except issues associated with four orders that are the subject of ongoing consultations between DOE and the Board's staff. These issues are discussed further below.

2.3.1 Directives System Order 251.1

Order 251.1 and its associated manual identify DOE's responsibilities for the development and review of its Directives System documents, including policies, orders, notices, manuals, and guides. Since this order is applicable to the orders of interest to the Board, i.e., those that ensure the health and safety of workers and the public, the Board is keenly interested in its adequacy of with regard to the responsibilities, accountability, and participants in the process of order development and revision; the metrics used in evaluating the adequacy of health and safety requirements when new orders are being developed or old ones are being revised; and the effectiveness of program direction and communication. Regarding implementation, the order and manual require directives to include Contractor Requirements Documents (CRDs), which identify requirements that are to be imposed on contractors. When incorporated into contracts, the CRD requirements become mandatory.

A number of new and revised orders issued as part of DOE's Order/Requirement Reduction and Streamlining actions are now nearly 2 years old, at which point DOE's policy

requires a review to determine whether cancellation, revision, or continuation is appropriate. DOE calls this process its "sunset" review.

Under the sunset provision, orders and manuals are undergoing periodic review and revision, and orders are being revised even in cases where contractors have not yet finished evaluating and adopting the original orders. The Board is concerned about the unnecessary review and update of orders that are already adequate. The process places an unjustified drain on critical resources of the Board, as well as on resources of DOE and its contractors. Those resources would be better applied to establishing sound ISM programs. The Board expressed its interest in this matter to the Secretary of Energy in a letter dated November 12, 1997, which included suggestions for effectively addressing this issue. The Board also noted that while there may well be justification for specific new or revised directives in the interest of improved safety, changes that do not result in substantial benefit should be avoided. Constantly revising adequate safety standards threatens to disrupt the process of incorporating these standards into contracts and implementing them in the field as part of ISM programs.

Several meetings between DOE and the Board's staff have proven to be effective in resolving the Board's concerns relative to this order, and continuance of this productive interface is expected to result in closure on remaining issues in early 1998.

2.3.2 Life Cycle Asset Management (LCAM) Order 430.1

Order 430.1 provides requirements and guidance that together serve as a framework for ensuring that health and safety requirements are incorporated into the design, construction, operation, and decommissioning phases of a facility's life cycle. Without this framework, DOE projects have historically been conducted in a segmented, unintegrated manner that is more likely to result in inadequate identification of hazards or design requirements to address them, and loss of configuration control for safety systems, components, and structures through the entire life cycle of the facility.

Considerable Board resources were expended in 1995 in reviewing DOE Order 430.1 and associated guidance; the order was found acceptable to the Board in its original issue. During 1997, the Board's staff reviewed several drafts of DOE's requirements and guidance for implementing facility deactivation, surveillance and maintenance, and decommissioning, which DOE intends to include in an update to be designated DOE Order 430.1A. Following a detailed review of the latest draft documents by the Board's staff, the Board concluded that the latest draft revisions failed to meet DOE commitments related to health and safety made in a March 13, 1997, letter from the Under Secretary. These commitments included (1) adding appropriate requirements and guidance from DOE Order 5820.2A to the LCAM Order, (2) linking specific handbooks and guides to the LCAM order, and (3) completing the Facility Disposition Manual. The Board found that DOE had apparently retreated from the level of safety incorporated in previous documents and had omitted an essential CRD. In addition, DOE had excluded a set of draft directives previously submitted to the Board that approached facility dispositioning in a

systematic manner that would include integration of detailed proven techniques, such as the deactivation endpoint method, to ensure that the health and safety of workers and the public were adequately addressed. These views were transmitted to the Secretary of Energy in a letter dated October 3, 1997. The Board believes that parts of the LCAM order should be redrafted and has requested that DOE provide a report identifying a proposed path forward for the resolution of issues raised by the Board.

The Board's objective is to help ensure that the health and safety of workers and the public are protected during the intense deactivation and decommissioning activities planned for many hazardous DOE defense nuclear facilities during the next decade.

2.3.3 Facility Safety Order 420.1

Order 420.1 and associated guidance are of particular importance since they provide requirements and guidance to ensure that the health and safety of workers and the public are adequately considered in the designs for new nonreactor nuclear facilities. All new DOE nuclear facilities fall in this category. The guidance provided is intended to represent sound lessons learned by DOE in such areas as hazards analysis methodology and design approaches. During its review of this Order, the Board successfully urged DOE to add appropriate references to consensus standards that have been applied in the commercial nuclear industry to ensure safe designs.

The Board's dissatisfaction with the original drafts of DOE Order 420.1 was adequately addressed in the October 1996 issue of the order. However, the radiation dose guidelines and worker protection provisions of the order's guidance documents are open issues that were the subject of several 1997 meetings between the staffs of the Board and DOE. It is expected that further meetings in 1998 will lead to satisfactory resolution of these issues.

2.3.4 Radioactive Waste Management Order 435.1

Order 435.1 is important to the health and safety of workers and the public because it provides requirements for the treatment, storage, and disposal of high-level, low-level, and transuranic waste.

Recommendation 94-2 was issued as a result of the Board's observations that DOE was not adequately addressing low-level radioactive waste issues. The recommendation identified, among other things, the need to perform a comprehensive complex-wide review of the low-level waste issue, and the need to develop and issue ". . . additional requirements, standards or guidance on low-level waste management that addresses safety aspects of waste form and packaging, burial ground siting and performance assessment, facility design, construction, operation, and closure, and environmental monitoring . . . ." In its implementation plan for Board Recommendation 94-2, DOE committed to produce a waste management directive to replace

DOE Order 5820.2A. Additional assurances concerning that commitment were made by DOE during the public meeting held by the Board in December 1996.

The Board's staff reviewed several preliminary drafts of the proposed replacement order, manual, and supporting implementation guidance documents during 1997. Major areas requiring improvement were discussed between the staffs of the Board and DOE. These deficiencies included (1) excessive reliance on qualitative and subjective terms to describe requirements for measures of compliance, (2) lack of specificity in designation of regulatory and other drivers for requirements, and (3) overall lack of specificity in the implementation guidance documents. Staff-to-staff meetings in 1998 are expected to be aimed at resolving the health and safety issues satisfactorily and completing the development of these directives.

2.4 TECHNICAL EXPERTISE OF DOE STAFF

The report of the Senate Armed Services Committee on S. 1085 that accompanied the legislation establishing the Board includes the following statement: "The Board is expected to raise the technical expertise of DOE substantially . . . ." Since its inception, the Board has continually stressed to senior DOE managers the absolute necessity of providing the highest level of technical expertise possible for members of the DOE staff, both in Headquarters and in field elements responsible for overseeing the performance of DOE's contractors. DOE has taken a number of important steps in this area, but much remains to be done.

2.4.1 Upgrading DOE Technical Competence Complex-Wide

Technical competence of federal workers is essential to operational safety at DOE's defense nuclear facilities. Congress, the Board, and other external agencies have long emphasized the need for improving the technical competence of both federal and contractor personnel in the defense nuclear complex.

Definitive actions to address this problem had been taken in years prior to 1997. In June 1993, the Board focused DOE's attention on this issue via issuance of Recommendation 93-3, *Improving DOE Technical Capability in Defense Nuclear Facilities Programs.* Since that time, DOE has made considerable progress on several aspects of the approved 93-3 implementation plan:

- For the first time in DOE's history, a standardized technical qualification program was developed and implemented for approximately 1,800 federal employees. Although the program must be further refined, a baseline technical qualification program has been established.

- With significant Board involvement, DOE pursued and was granted an excepted service hiring authority for 200 positions (in addition to the 200 positions previously

authorized under the DOE Organization Act). This authority is available to fill key engineering, scientific, and other technical positions with experts having outstanding credentials. The hiring authority for these additional positions was to expire in September 1997, but with the Board's prompting, DOE was successful in obtaining from Congress an extension of the hiring authority for an additional 2 years. Despite Congressional actions in this arena, the number of highly qualified technical personnel hired by DOE using this authority has been minimal. Those DOE Operations Offices that have successfully used this hiring authority have experienced a positive impact in the safe operation at their respective sites as a result of involvement of these excepted service personnel in various programs (e.g., the Richland Operations Office, Rocky Flats Office, and Oak Ridge Y-12 Site Office).

- Although funding for most DOE programs has decreased during the last several years, as have authorized staffing levels, some offices have identified critical staffing needs and have hired employees with outstanding technical qualifications (e.g., the Richland Operations Office, the Oak Ridge Y-12 Site Office, Rocky Flats Office, and Amarillo Area Office).

- In a 1996 conference, DOE Operations Office managers and Headquarters line management reviewed their organizations and identified more than 251 senior technical safety management positions (existing, as well as needing to be created) required for continued safe operation of defense nuclear facilities.

However, DOE has not yet achieved all of the improvements envisioned in its 93-3 implementation plan. DOE concluded in early 1997 that approximately 40 percent of the commitments in the plan have not been met or have not achieved the desired effect. This observation was the impetus for actions in the remainder of the year.

As a result, the Board requested by letter on April 2, 1997, that DOE revise the 93-3 implementation plan to reflect current DOE initiatives and provide realistic deliverables and milestones. DOE accepted the need to revise the plan in an April 1997 letter, and DOE commenced working with the Board toward this objective. However, progress stalled when DOE informed the Board by letter in September that much of the headway made by DOE during the past few years in improving its technical capabilities might be undone by a reduction in technical work force in response to reduced funding levels proposed by Congress at that time. The letter also stated that, as a result of existing government regulations (over which DOE stated it had no control), a number of technically qualified DOE employees hired in response to Recommendation 93-3 might have to be terminated. When Congress approved the FY 1998 DOE budget, DOE determined that the possibility of a large reduction in force had been averted. However, DOE's personnel actions had been virtually paralyzed during this interim period of funding uncertainty, and no meaningful personnel plan was generated that fully considered the safety and health responsibilities of DOE.

In an October 1997 letter to DOE, the Board stressed that DOE must prepare in advance to avert the loss of technically competent safety personnel in the face of likely future budget reductions. The Board stressed that while DOE must comply with government regulations as they affect any downsizing, it must also preserve the technical expertise needed to perform the functions essential to protect the public health and safety, as provided under the Atomic Energy Act of 1954, as amended. Any actions to preserve technical expertise should include staff in key health and safety positions, such as DOE Facility Representatives at defense nuclear facilities, competent personnel in senior technical safety management positions (identified during the implementation of Recommendation 95-2), and critical technical expertise developed under the Technical Qualification Program of Recommendation 93-3. The Board also noted that other federal agencies are exploring new strategies to overcome some of the inflexibility imposed by existing personnel law as a means to gain control over their ability to hire and retain a qualified technical work force. The Board suggested that DOE consider new and perhaps similar methods to ensure its ability to retain highly qualified individuals.

The accomplishment of DOE's present and future missions in a manner that protects the health and safety of workers and the public depends heavily on the technical qualifications of DOE personnel who are assigned safety-related responsibilities. It is not clear that DOE has fully understood the importance of this message or that sufficient senior management attention and commitment are being applied to this issue. At the time of this report, a DOE working group had provided to the Board's staff a draft revised implementation plan for Recommendation 93-3 to further the effort to arrive at a mutually agreeable path forward.

2.4.2 Facility Representative Program

In May 1992, the Board issued Recommendation 92-2, *DOE's Facility Representative Program at Defense Nuclear Facilities,* to address needed improvements in DOE's Facility Representative Program. DOE's Facility Representatives are meaningful contributors to safety management at the sites, and are instrumental to overseeing the discipline of contractor operations at defense nuclear facilities, as required in DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*. During implementation of Recommendation 92-2, DOE invested significant resources to upgrade the Facility Representative Program at most of its Operations and Area Offices. As a result of DOE's successful implementation of the program, the Board closed Recommendation 92-2 in October 1996. In its September 17, 1997, letter to DOE, the Board concluded that the success of this program was due in part to the personal and persistent role played in its implementation by the Associate Deputy Secretary for Field Management and commitment to the program on the part of DOE's Field Operation Managers.

Despite their small numbers (5–10 percent of field manning), Facility Representatives are generally making considerable positive contributions to safety and efficiency. The Board believes the Facility Representatives to be among the most effective safety management employees within DOE. Most of these highly trained employees were added to DOE's rosters in recent years through special hiring programs that the Board supported. Facility Representatives had to meet

high standards defined specifically for their field assignments. The Board notes that some sites have recognized the growth potential of their Facility Representatives and have assigned these individuals additional responsibilities commensurate with their education, training, and capabilities.

In response to Recommendation 92-2, DOE developed a comprehensive program guidance document, DOE-STD-1063-93, *Establishing and Maintaining a Facility Representative Program at DOE Nuclear Facilities*, in August 1993. This standard borrowed heavily from similar successful programs operated by the Naval Nuclear Program and the Nuclear Regulatory Commission (NRC). Working closely with the Board's staff, DOE revised and issued a much improved DOE-STD-1063 in November 1997, incorporating many of the lessons learned thus far in the program.

The Board notes that Recommendation 92-2 has been one of the recommendations most successfully implemented by DOE. The success of this program emphasizes the importance of ensuring that DOE does not reduce the number of technically qualified Facility Representatives during any future downsizing activity. It is for these reasons that during 1997, the Board has so strongly urged actions by DOE to protect the jobs of the new Facility Representatives.

2.5 DESIGN AND CONSTRUCTION OF DEFENSE NUCLEAR FACILITIES

2.5.1 Overview

As noted earlier, the Board's enabling statute mandates review of the design and construction of not only new DOE defense nuclear facilities, but also significant modifications to existing facilities. Several such projects currently under way and in varying stages of completion are needed (1) to ensure the safety and reliability of existing nuclear weapons and to provide component evaluation capabilities in the absence of future underground nuclear testing; or (2) to stabilize and store large quantities of high-level nuclear waste, plutonium, and other hazardous legacies of the production of nuclear weapons.

From its inception, the Board has conducted reviews of important defense nuclear facility design and construction projects, urging DOE to plan and conduct these projects in an integrated, systematic manner. Early in its history, the Board expressed its concern with DOE's procurement and contracting systems that often divide projects into several separable stages, usually with different contractors responsible for each. This practice commonly caused a lack of continuity within projects, and it has historically been the cause of problems in integrating component parts of systems required to perform hazardous functions. The Board has consistently maintained that project management is significantly improved when a single, clearly responsible individual is provided the authority to lead a project.

Earlier actions by the Board had sought to institute a methodical use of systems engineering for Hanford's Multi-Function Waste Tank Facility (MWTF). Early application of this methodology revealed the weakness of arguments for the need for that facility, so it was dropped from the program. The Board has continued to urge the use of this valuable methodology of the Tank Waste Remediation System (TWRS), of which the MWTF had been a part. The Board has also encouraged use of systems engineering for other projects at the Hanford Site, especially for the remediation of spent fuel in the spent fuel basins at the deactivated K-Reactors.

Other important actions by the Board in this vein have included application of systems engineering concepts to the DOE-wide processes for remediation of facilities formerly used to produce and process plutonium, to remediation of facilities at which uranium-233 is stored, and to future use of Building 371 at RFETS. These actions are described in this report.

2.5.2 1997 Reviews of DOE Design and Construction Projects

During 1997, the Board reviewed a number of DOE's design and construction projects. The results of these reviews have been shared with DOE and contractor personnel through out-briefs by the Board's staff following site visits, staff trip reports, Board letters, and Board interaction with DOE and contractor management. Such reviews of design and construction are planned for continuation during 1998. The more significant project reviews during 1997 are discussed in the following paragraphs.

LANL Capability Maintenance and Improvement Project (CMIP)

The objectives of CMIP are to (1) improve the capability to carry out current missions by maintaining and improving facilities, and (2) develop the capacity for limited-scale manufacturing of plutonium pits for nuclear weapons. Board reviews of the design process and the Enhanced Conceptual Design Report for CMIP disclosed the need for more effective project management by both DOE and LANL, to ensure early identification of hazards and effective development of controls during the design stage. Weaknesses that were identified included the lack of adequate safety design criteria, which should have been developed during the conceptual design phase. These weaknesses were symptomatic of the need for technical personnel experienced in the management of major, complex, hazardous projects and for the implementation of suitable technical project management processes, such as those contained in DOE Order 430.1, *Life Cycle Asset Management*, and its associated guidance documents. The Board's views and the identification of specific areas to be evaluated further by DOE for health and safety implications of the project were identified in a letter dated December 5, 1997, to the Assistant Secretary for Defense Programs.

Savannah River Site Projects

Actinide Packaging and Storage Facility (APSF). Board Recommendation 94-1 addressed in part the need to stabilize hazardous surplus plutonium metal and oxide and provide

safe interim storage of this material. APSF is intended to be used for safe stabilization and storage of plutonium metal and oxide and other special nuclear material for up to 50 years.[3] The facility is sized to include equipment for safely stabilizing existing material at SRS and to store material from RFETS and SRS; it may be increased in size to store special nuclear material from the Hanford Site as well. Construction of the APSF is scheduled to begin in mid-1998; the facility is scheduled to start up in late October 2001.

During 1997, the Board performed a preliminary review of the performance of the SRS Management and Operating contractor, Westinghouse Savannah River Company (WSRC), in ensuring that nuclear safety was appropriately factored into the APSF design. The Board's staff observed that while the overall design seems to be appropriate to meet the objectives, WSRC review of the subcontracted design has been neither frequent enough nor in sufficient depth for early identification of problems, e.g., in the civil and geotechnical functional areas. In addition, insufficient attention has been given to evaluation of the site and to seismic design criteria. In 1998, the Board intends to continue its safety oversight during the development of the design of this important facility, to ensure that safety requirements and operational considerations are adequately addressed as the design work continues.

Tritium Production Options. On December 6, 1995, the Secretary of Energy issued a Record of Decision announcing that DOE would pursue a dual track on the two most promising tritium supply alternatives: (1) the purchase of an existing commercial reactor or reactor irradiation services at such a reactor, with an option to purchase the reactor for conversion to a defense facility; and (2) design, building, and testing of critical components of an accelerator system for tritium production. It is anticipated that in late 1998, the Secretary of Energy will select one of these two tracks to serve as the primary source of tritium. The other is to be developed as a backup capability.

During this past year, the Board reviewed the safety aspects of the conceptual design of the facility for extracting tritium from irradiated rods and the conceptual design of an accelerator system for tritium production. In general, both conceptual designs were satisfactory from a safety standpoint. Both projects are now in the preliminary design phase. As these designs develop, the Board intends to continue its safety oversight.

Rocky Flats Environmental Technology Site Projects

Building 371 Upgrades. The purpose of Recommendation 94-3 was to ensure that projected storage of special nuclear material in Building 371 at RFETS would be done safely. The Board recommended that DOE first determine what changes were needed to upgrade the facility for safe storage, and then upgrade the facility while establishing an adequately safe basis for operation. In January and February 1997, the Board performed reviews that indicated DOE's

[3]Operational considerations associated with the proposed construction of the APSF are discussed in Section 4.5.2.

commitments to implement this recommendation were in jeopardy. Specifically, (1) a sufficiently rigorous basis for safe operation was not being developed, and (2) priority upgrades to render the facility safe for its plutonium storage mission were not being designed and installed with the requisite urgency. These concerns were expressed in a Board letter dated May 16, 1997, to the Assistant Secretary for Environmental Management. As a result of interactions between the Board's staff and DOE's Rocky Flats Field Office and contractor senior management, the Board's interest in this matter was acknowledged, and corrective actions were undertaken by both DOE and the contractor.

In September 1997, the Board's staff performed a follow-up visit to RFETS to review the status of DOE's progress in addressing the two matters identified above. As noted in the Board's letter dated October 15, 1997, to the Secretary of Energy, the installation of priority upgrades was on schedule, and the initial authorization basis document was complete. The Board's letter also noted the need for (1) sound justification for delays in the installation of additional safety margin upgrades previously committed to by DOE, and (2) a commitment to provide safety measures—or sound justification for not doing so—for addressing accident scenarios exceeding evaluation guidelines, as committed to previously by DOE.

Hanford Projects

Spent Nuclear Fuel Project. The K-Basins, located only a few hundred yards from the Columbia River, were not designed for long-term storage of spent nuclear fuel. Their structural integrity could be threatened by natural phenomena, especially potentially damaging earthquakes. Both the increasing levels of radioactivity liberated into the basins as 105,000 radioactive fuel elements disintegrate and the vulnerability to release of radioactive matter due to unlikely yet possible natural phenomena make removal of the fuel from the basins a priority activity.

In the early 1990s, members of the Board made numerous trips to the Hanford Site to gain a comprehensive understanding of this issue and to communicate the need for DOE to resolve the issue in an integrated manner. In response, DOE and the contractor established the Hanford Spent Nuclear Fuel Project (SNFP) in early 1994. Under the SNFP, all activities associated with the stabilization of the fuel in the K-Basins are conducted on an integrated basis.

The Board subsequently became increasingly concerned with the lack of urgency in DOE's schedule for safe stabilization of this spent nuclear fuel and other especially hazardous surplus fissile materials in the defense nuclear complex. As a consequence, the Board issued Recommendation 94-1 in May 1994. Among other points, Recommendation 94-1 urged that the SNFP be accelerated. As a result of vigorous interactions between DOE and the Board's staff, DOE's implementation plan for Recommendation 94-1 committed to a program for initiating removal of fuel from the K-Basins by the end of 1997 and completing removal by December 1999.

Although earlier engineering studies had identified stabilized dry storage as the best method for interim storage of the type of fuel in the K-Basins, characterization data developed during 1997 indicated a need for design changes and additional development of the process, with a significant impact on the project's schedule. In August 1997, DOE and its contractors announced that the start of fuel removal would be delayed at least until July 1999. As a result, the Board initiated an in-depth technical and project review. This review identified deficiencies in the project's processes and practices for identifying and resolving technical and safety issues that collectively could cause additional delays in the safe, expeditious stabilization and storage of the deteriorating spent nuclear fuel. The results of this review were documented in DNFSB/TECH-17, *Review of the Hanford Spent Nuclear Fuel Project.* This report was forwarded by a letter dated November 17, 1997, to the Assistant Secretary for Environmental Management. The Board encouraged DOE and its contractors to develop increased strength in technical management and provided advice in the form of examples of how improved project execution could avert further schedule delays.[4]

DOE Oversight of Hanford Design and Construction Projects. The Board's reviews of a wide range of Hanford design and construction projects identified two significant areas with potential impact on the health and safety of workers and the public: (1) the questionable independence of the contractor organization performing acceptance inspection of completed construction for the government and, (2) the breakdown in configuration management, i.e., the lack of priority attention being given to the update and maintenance of drawings, procedures, equipment labeling, and other configuration management products that are essential to the safe start-up and operation of facilities. In February 1997, individual Board members discussed these matters with DOE-RL. In a letter dated April 14, 1997, to the Assistant Secretary for Environmental Management, the Board transmitted a report from the Board's staff on these issues for DOE's use in addressing them. Continued Board interest and subsequent reviews by the Board's staff were key factors that resulted in (1) the Acceptance Inspection function for DOE-RL being reassigned to an independent contractor organization on June 30, 1997; (2) initiation of programs for redrawing the diagrams for layouts of systems at the K-Basins, (3) significant improvement in programs for the tank farms, and (4) selected actions to upgrade drawings for other facilities, including those for the site's electrical utilities. These latter efforts are widely regarded by facility operators as improving their personal safety, while simultaneously making their work more efficient and effective.

2.6 STUDY OF HEALTH EFFECTS OF PLUTONIUM UPTAKE BY WORKERS

The Board was influential in convincing DOE to commit funding in fiscal year 1997 to enable Dr. George Voelz of LANL to continue a long-term study of plutonium workers who had experienced internal radiation exposures from plutonium. The plutonium had entered workers' bodies by inhalation and ingestion or through wounds, and some of it had been retained in their

[4]Operational aspects of SNFP delays are discussed in Section 4.2.2

bodies. "Fifty Years of Plutonium Exposure to the Manhattan Project Plutonium Workers: An Update," published in the *Journal of the Health Physics Society*, addressed the study of plutonium exposure to a group originally consisting of 26 workers who performed plutonium research and development in the 1940s. This paper provided additional evidence that plutonium may not be as toxic as feared by some. Although 8 of the 26 workers had been diagnosed as having one or more cancers, that rate is within the range expected for unexposed individuals.

This work had previously been transferred by DOE's Office of Environment, Safety and Health (ES&H) from LANL to the Department of Health and Human Services' National Institute for Occupational Safety and Health (NIOSH). NIOSH later dropped the study, alleging that it was too small to be statistically significant, and then ES&H decided not to continue to fund it. Subsequently, in response to urging from the Board, DOE provided $90,000 for the study for FY 1997. The Board understands that LANL and the Amarillo National Resource Center for plutonium are discussing the possibility of collaborating on this work in the future.

This is a long-term clinical and postmortem dosimetric and epidemiological study of a unique population. As of 1996, mortality within the study group was only about 27 percent, but is projected to reach 75 percent within the next 10 years, based on normal life expectancies. The Board agrees with the authors of the 50-year study update that continued study of persons exposed to plutonium, current and past, is necessary for improved understanding of risks. Therefore, the Board believes that adequate funding should be made available to continue the health studies of the remaining plutonium workers.

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3. MANAGEMENT AND STEWARDSHIP OF NUCLEAR WEAPONS

3.1 INTRODUCTION

The Board has a unique role in overseeing the safety of operations in the DOE nuclear weapons complex to ensure that these vital national security activities are conducted in a manner that adequately protects the health and safety of workers or the public. The following sections provide an overall context for the Board's actions in this area. Subsequent sections, beginning with Section 3.7 (Pantex Plant), provide details of the Board's actions and accomplishments at weapons-related sites in 1997.

Congress amended the Board's enabling statute in 1991, eliminating certain exclusions from the definition of a defense nuclear facility contained in the original statute. As a result, the Board now has oversight safety responsibility for the assembly, disassembly, and testing of nuclear weapons and weapons components. Since the 1991 amendments, a major thrust of the Board's oversight has been to review and assess safety management programs for the design, operation, and maintenance of weapons facilities and activities, and to compare such programs with other nuclear programs both within and outside the DOE complex. These reviews have led the Board to identify several major safety issues that address fundamental components of safety management programs required for these operations. Nuclear weapons involve both nuclear materials and conventional high explosives. The experience the Board and DOE gained in addressing the hazards of working with these materials and those involving the hazardous remnants of weapons production has led to an understanding of the need for Integrated Safety Management (see Sections 2.1 and 2.2). It is, therefore, important to describe those major Board actions at nuclear weapons facilities that have provided the foundation for its current emphasis on Integrated Safety Management. Later sections of this report provide specifics of the Board's activities, past and present, at each nuclear weapons-related site.

During the last 6 years, the Board's oversight of weapons activities has been strongly influenced by a defense nuclear complex in the throes of downsizing and mission change. As a matter of national policy, production of new weapon systems has stopped, and dismantlement of a large fraction of the nuclear weapons stockpile is under way. With the Administration's commitment to the Comprehensive Test Ban Treaty, all underground testing of nuclear weapons has ended as well. These changes are significantly affecting the way DOE ensures safety in its facilities for research, manufacturing, assembly, disassembly, and testing of nuclear weapons.

Existing weapon systems are likely to remain in the nation's stockpile longer than in the past, potentially much longer than their original design lifetime. New methods are expected to be necessary to ensure that operations involving nuclear weapons remain safe while the weapons are in DOE custody. In the absence of underground nuclear testing, alternative means to confirm the safety and reliability of weapons at all stages in their life cycle are being developed. DOE's strategy for dealing with this challenging new mission is embodied in its Stockpile Stewardship

and Management Plan.[5] This plan provides for continuation of the ongoing defense missions at eight DOE sites, and includes appropriate adjustments consistent with post-Cold War national security policies.

At the same time, many of the remaining facilities for the assembly, disassembly, and testing of nuclear weapons—designed and constructed in the period between the late 1940s and 1960s—are aging and becoming obsolete. DOE is taking actions to address this issue, including refurbishing facilities intended for continued use and changing the functions of other facilities. DOE's plans also call for construction of selected facilities, including some with enhanced experimental capabilities, which are to operate at the national weapons laboratories. Weapons manufacturing capabilities at some existing plants are to be maintained, but their capacity is expected to be appropriately reduced. In addition, a limited capability for manufacturing components of plutonium pits is scheduled to be reestablished at a national weapons laboratory.

This dynamic situation demands that the Board exercise significant flexibility and maintain the technical expertise needed to deal with the myriad of unique safety issues that arise as DOE upgrades the safety of the defense nuclear complex, reduces its overall size, and modernizes its capabilities. Virtually all members of the Board's technical staff work in support of the technical safety oversight of weapons activities, including a group of individuals with extensive DOE and DoD nuclear weapons expertise. One member of the Board's staff, because of his 42 years of experience in nuclear weapons design, has been repeatedly sought out by his former nuclear weapons laboratory employer to participate in the preservation of knowledge.

During the past 6 years, the Board has interacted frequently with DOE to improve the management of safety in nuclear weapons operations. Since 1992, the Board has sent almost 100 written communications to DOE regarding issues and observations that affect the safety of weapons activities and facilities. Beneficial changes have resulted, as subsequent discussions in this section indicate. Upgrades stimulated by Board action are being accomplished without consequences detrimental to DOE's weapons mission.

3.2 INTEGRATED SAFETY: GENERAL APPROACH

Early on, the Board determined that two distinct and inconsistent safety management programs existed at nuclear explosive facilities—one for nuclear explosive operations and another for operations involving nuclear materials no longer in weapons. Further, the Board noted that the existing safety management system for nuclear explosive operations was largely expert-based, as opposed to the more standards-based approach that was pioneered by the Navy Nuclear Program and the commercial nuclear industry and that was in the process of being implemented at other DOE nuclear facilities. The Board identified two potential problems associated with DOE's

[5] *The Stockpile Stewardship and Maintenance Program* , U.S. Department of Energy, Office of Defense Programs, May 1995.

expert-based approach: (1) weapons experts were retiring and, for the most part, leaving a void in knowledge and expertise at the nuclear weapons design laboratories, and (2) safety bases for nuclear weapons activities lacked documented rigor.

The Board's initial reviews of nuclear weapons facilities highlighted certain analytical and operational matters that needed to be upgraded in the long term. At Pantex alone, numerous safety analysis reports for a large number of facilities needed to be developed for the first time or upgraded. Safety analyses did not exist or were deficient at other weapons sites as well. The safety analyses that were available often were not prepared in accordance with currently accepted industry guidelines (or with a recently issued DOE order for safety analyses), and did not incorporate modern methods of analyzing the safety of facilities and operations. Without adequate facility and activity safety bases to guide operations, some risks may not be identified and, as a result, may be inadequately controlled.

In the first few years of overseeing weapons facilities and activities, the Board identified several significant operations for which applicable safety requirements, guidance, and controls were either not identified or not adequately implemented. In early 1994, the Board informed DOE of inadequacies in design basis information involving facility safety systems, in configuration management, and in flow-through of technical requirements to operational procedures at the Pantex Plant and at the Plutonium Facility (TA-55) at LANL. Later that year at the Y-12 Plant, the Board's staff observed personnel not following fissile material handling procedures that were established to prevent criticality incidents. Further scrutiny led to discovery of many more violations of safety procedures and overall poor conduct of operations. In 1995, a Board review revealed that Technical Safety Requirements applicable to Building 332, the Plutonium Facility at LLNL, were not being followed. In all four cases, operations were suspended pending correction of the problems.

3.3 REQUIREMENTS AND GUIDANCE FOR SAFETY OF NUCLEAR EXPLOSIVE OPERATIONS

One of the most significant Board initiatives to establish the foundation for Integrated Safety Management at nuclear weapons facilities dealt with the improvement of the fundamental requirements and guidance for safety of nuclear explosive operations. The Board issued Recommendation 93-1, *Standards Utilization in Defense Nuclear Facilities*, recommending that DOE address the differences between the safety requirements applicable to nuclear explosives facilities and those applicable to other defense nuclear facilities. Pursuant to this recommendation, DOE performed a detailed assessment of its program for the safety of nuclear explosive operations during 1994 and early 1995. The results of this assessment were then codified in a fully revised set of draft DOE orders and standards applicable to nuclear explosive safety.

During 1996, DOE completed revising most of its nuclear explosive safety directives. The directives now include two orders, an implementation guide, a technical standard on the safety study process, and an interim rule on the Personnel Assurance Program. A second technical standard for performing hazard analyses is in use in draft form and being finalized. These new safety requirements meet the objectives of Recommendation 93-1. When fully implemented, they are likely to provide increased assurance that operations at those facilities that assemble, disassemble, and test nuclear weapons can provide the requisite protection of the public, workers, and the environment.

3.4 WEAPONS EXPERTISE AND DOE STAFFING

A consistent theme of the Board has been that DOE and its contractors require knowledgeable personnel to execute their safety management functions (see Section 2.4). The Board issued Recommendation 93-6, *Maintaining Access to Nuclear Weapons Expertise in the Defense Nuclear Facilities Complex*, to highlight the need to retain access to and capture the unique knowledge of individuals who have been engaged for many years in the assembly, disassembly, and testing of nuclear weapons, so as to avoid future safety problems. The Board noted that many individuals are being lost from the defense nuclear complex as a result of retirement incentives, layoffs, and other downsizing activities, and that these individuals possess information that is not presently captured or documented. Retention of this information is essential if DOE is to maintain the capability to safely manage and maintain the weapons stockpile, and conduct dismantlement activities.

As a result of Recommendation 93-6, a new document was developed to capture, in a single reference, all design and safety information relevant to safety of nuclear explosive operations for each existing nuclear weapon. This document, *Weapon Safety Specifications,* records the hazards of each weapon system, including information gleaned from focused preservation of knowledge and other useful historical information; these specifications have been issued for all existing weapon systems.

In 1996 and 1997, more than 100 individual and group archiving interviews of retired weapons experts were conducted by the weapons laboratories and organizations from sites involved in weapons production and testing. Records of the dismantlement process that were in danger of becoming irretrievable were also preserved as part of this archiving effort. In addition, DOE-Nevada and LANL have made significant progress toward completing commitments under Recommendation 93-6 to preserve knowledge associated with underground nuclear testing; archiving efforts at LLNL have not been as successful to date.

The Board's actions have also led to significant enhancements of the technical capability at key DOE Field Offices where work on maintaining nuclear weapons capability continues to reside, namely the DOE Amarillo Area Office at the Pantex Plant and the DOE Y-12 Site Office at Oak Ridge. The Y-12 Site Office, in particular, conducted a nationwide search for highly

competent candidates. The positive effects of these newly hired individuals have been noted by the Board in such subject areas as improvements in the analysis, documentation, and control of the safety envelope; improvements in personnel training and qualification; and the exercise of more formal control of nuclear weapons dismantlement. Each of these improvements can be directly attributed to the increases in the technical ability of the staffs.

3.5 READINESS REVIEWS OF SAFETY PRIOR TO HAZARDOUS OPERATIONS

The Nuclear Explosives Safety Study (NESS) process is the primary method by which DOE evaluates the safety of various operations involving nuclear explosives. A 6-month review of this process conducted by the Board's staff during 1993 resulted in the Board calling for an independent expert review of the NESS process. Subsequently, a 1994 review was conducted by a team composed of nuclear safety professionals from DoD and the DOE nuclear weapons laboratories. Completion of this review in May 1994 led to DOE developing a NESS Corrective Action Plan, which addressed measures for significant program improvements.

Another key aspect of Integrated Safety Management, which the Board caused DOE to initiate early on, is the function by which DOE ensures the readiness of facilities to operate safely prior to initiating hazardous operations. This topic has been the subject of four Board recommendations in the last 7 years. Specific to weapons activities, the Board has emphasized the development of requirements and guidance tailored to the unique hazards of nuclear explosive safety (the NESS) and the broader-based reviews involving all aspects of safety for readiness to conduct weapons activities. The Board has also spent considerable effort ensuring that the actual conduct of readiness reviews for operations at sites such as the Pantex Plant, the Y-12 Plant, and LANL is completed satisfactorily.

Guidance for broad-based readiness reviews of nuclear weapons operations was developed by DOE in response to the Board's Recommendation 92-6, *Operational Readiness Reviews*. The guidance requires that after certification by contractor and DOE line management of readiness to perform weapons-related activities, a Qualification Evaluation (QE) be performed as an independent check of the adequacy of safety controls. The QE, performed by a team of weapons laboratory personnel, assesses the adequacy and correctness of the procedures for weapon assembly or disassembly, and verifies that safety considerations have been addressed.

3.6 SAFETY IN NUCLEAR RESEARCH AND DEVELOPMENT

In late 1994 and throughout 1995, the Board called for a series of briefings by DOE and representatives of the three nuclear weapons laboratories that focused on the integrated management of safety at DOE's weapons research and development (R&D) facilities. Nuclear R&D requires an environment that encourages creativity and fosters a management approach that is flexible enough to permit the safe execution and control of a wide variety of activities. The

weapons laboratories had expressed concern that DOE's safety management approach at that time did not permit the required flexibility and was not improving R&D operational safety.

As a result of these briefings and other assessments, the Board requested that DOE provide a report that would address whether there is adequate DOE guidance on the subject of Integrated Safety Management of R&D activities. The report was to address how DOE planned to ensure the availability of adequate technical talent, mechanisms, and acceptance criteria; and what DOE needed to do to coordinate line management and independent oversight audits of safety at the weapons laboratories. DOE was encouraged to develop an exception approval process to address laboratory-proposed integrated safety management systems.

This reporting requirement, which served as a precursor to DNFSB/TECH-6, *Safety Management and Conduct of Operations at the Department of Energy's Defense Nuclear Facilities*, and Recommendation 95-2, *Safety Management*, noted that the nuclear safety standards made obligatory by DOE for its operating contractors have general applicability to the wide diversity of DOE activities. DOE's safety policy and the applicable standards permit a "graded" approach in which the formality of operations varies in form and degree depending on the nature and extent of the hazards involved. Acceptance criteria had never been well defined, however, nor could they be inferred from case histories. This was especially true for the weapons laboratories, where far more R&D activities are conducted than are production activities, and in which the mix of skills for R&D is much different from that required for production.

The nuclear weapons laboratories have maintained that their safety management programs should reflect this difference. The Board has long held that DOE requirements need not be applied in the same way at both production facilities and R&D laboratories; i.e., it is not a "one size fits all" situation. Believing that the laboratories are in the best position within the DOE complex to define a safety management program for facilities where R&D functions are dominant, the Board has encouraged them to do so. The reaction of management at the laboratories has been positive, as evidenced by the progress the laboratories are making toward developing Integrated Safety Management programs in response to Recommendation 95-2.

The following sections provide overviews of individual DOE nuclear weapons-related sites and specifics about the Board's nuclear weapons-related activities in 1997.

3.7 PANTEX PLANT

The Pantex Plant, located outside Amarillo, Texas, is DOE's site for maintenance and support of the active nuclear weapons stockpile, as well as the assembly, disassembly, and surveillance of nuclear weapons and the disposition of hazardous materials. In addition, Pantex serves as an interim storage site for retired weapons and strategic reserve plutonium and plays a central role in DOE's plans for stockpile stewardship and management. The Board has devoted considerable time and resources during the past 5 years to reviewing operations at Pantex,

including the development of adequate operational procedures and the appropriate confirmation of readiness to safely conduct the assembly, disassembly, and surveillance of nuclear weapons.

In the last few years, with encouragement from the Board, DOE developed an integrated plan for implementing safety improvement programs. This plan represents a cooperative effort among DOE, its Pantex contractor, and the national weapons laboratories. It identifies improvements and efficiencies that are intended to allow DOE to convert its improved safety concepts expeditiously into true safety benefits for Pantex operations. DOE has also significantly improved its program for assessing the safety of operations with nuclear explosives. The improved process, as described in the new DOE Orders 452.1A, *Nuclear Explosive and Weapon Safety Program*, and 452.2A, *Safety of Nuclear Explosive Operations*, together with their associated implementing guides and standards, has begun to increase the technical rigor of nuclear explosive safety reviews and the quality of technical information on which these reviews are based.

Dismantlement of surplus nuclear weapons will undoubtedly continue through FY 1998. DOE plans to start two more weapons dismantlement programs, in addition to the W69 Dismantlement Program initiated in June of 1997. Each of these programs uses a dismantlement process that has undergone significant improvement over the original process used in disassembling the weapons for surveillance. The Board intends to review each new program, including all associated facilities, tooling, and procedures, to ensure the correct identification of hazards and implementation of controls to minimize risks to workers and the public. The Board also intends to monitor preparations for the start-up of each program, and conduct routine evaluations of ongoing dismantlement operations to ensure that the processes are properly executed.

The Board believes that aging of components and material may increasingly affect the safety of weapons programs, with regard both to weapons surveillance and weapons dismantlement programs. Of particular interest are the effects of lengthy interim storage periods of specific components, including plutonium pits. Aging effects are being reviewed in the context of the safety of activities required in the ongoing dismantlement, disassembly, testing, and storage of weapon components at the Pantex Plant.

Lastly, the Board has continued during 1997 to find problems with the content and implementation of the safety basis and resulting controls needed for safe operation of nuclear explosive activities at the Pantex Plant. For example, the Board and its staff have monitored DOE's efforts to resolve the impact of the potential hazards that lightning poses to nuclear explosive operations at Pantex.

3.7.1 Recommendation 93-1/NESSCAP

For several years, the Board has worked with DOE to improve the orders affecting the safety of nuclear explosive operations. In implementing Recommendation 93-1, *Standards Utilization in Defense Nuclear Facilities*, and the Nuclear Explosive Safety Study Corrective Action Plan (NESSCAP), DOE has produced a new series of safety-related orders, standards, and guides (the 452-series[6]) that, taken together, significantly improve the definition of what DOE expects of its contractors for ensuring safety in nuclear explosive operations. Consistent with its statutory requirement, the Board reviewed these new directives for adequacy and appropriateness and advised DOE relative to their substance and content.

However, implementation of the new orders, which are pivotal to the standards-based safety management program for nuclear explosive operations, has not proceeded as anticipated. The Board notes that there has been little progress in developing and implementing the hazard analysis report (HAR) standard covering weapon-specific hazards and controls referenced in the new-series orders, although the Board issued a letter in April 1996 urging implementation of all of the new-series orders and other directives. DOE has subsequently begun to develop HARs as the basis for establishing weapon-specific safety controls.

The Board's staff observed the development of a HAR for use in establishing specific safety measures and controls for the W69 Dismantlement Program. Based on the staff's observations, the Board raised several issues with the HAR development process in two letters to DOE in July 1997 and August 1997. The DOE response in October 1997 generally acknowledged the existence of the Board's issues for the W69 Dismantlement Program, but did not present an objective consideration of the fundamental issues or address corrective measures for future HAR development as the Board had suggested.

Although the Board commends DOE for its continuing efforts to develop an improved integrated safety process for nuclear explosive operations, the Board believes that DOE should move more aggressively to fully implement the many improvements defined in the new safety orders. Consequently, in December 1997, the Board requested DOE to prepare a report that would address DOE's path forward, including the following specific items:

- The plans of the Albuquerque and Nevada Operations Offices for implementing fully the 452-series orders and for using their associated standards and guides.

- A plan from the Deputy Assistant Secretary of Military Application and Stockpile Support (DP-20) for carrying out his responsibilities under the new orders, including overall management and direction of the DOE nuclear explosive safety program, an

[6]Including DOE Order 452.2A, *Safety of Nuclear Explosive Operations* ; DOE Order 452.4, *Security and Control of Nuclear Explosives and Weapons* ; and G 452.2A-1A, *Implementation Guide for DOE Order 452.2A.*

appraisal by the Operations Offices to evaluate their implementation of the new orders, and the process for approval of NESS reports and revalidations.

- The status of the draft HAR standard referenced in the 452-series orders and the schedule for its final publication and full implementation.

In late 1997, an emerging issue was associated with a new type of nuclear explosive safety study group evaluation, termed a Nuclear Explosive Safety Evaluation (NESE), developed by DOE's Albuquerque Operations Office. The Board found that DOE's initial use of the NESE process is inconsistent with DOE Order 452.2A and its associated DOE standard governing the nuclear explosive safety study process. In December 1997, the Board formally requested a briefing from DOE on the role of DOE Headquarters in the nuclear explosive safety approval processes and the status of all nuclear explosive operations directives prior to any further use of a NESE or changes to any nuclear explosive safety directives.

3.7.2 Weapons Programs

The Board's initiatives during the last several years have resulted in actions by DOE to significantly upgrade its safety management of stockpile support and dismantlement. During this period, dismantlement of several entire weapons systems has been successfully completed—the last W70 in November 1996, the W55 in December 1996, the B61-2 in March 1997, and the B61-5 in August 1997. During 1997, the Board and its staff carefully reviewed the development of other weapon dismantlement and stockpile surveillance programs, namely the W69 and W79 Dismantlement Programs, and the W76 and W78 Surveillance Programs. Continued Board attention is likely to be required to ensure that improvements are applied to these programs on an acceptable schedule and in a fully integrated manner.

3.7.3 W69 Dismantlement Program

The NESS for the W69 Dismantlement Program was conducted in April 1997, concluding that, "upon resolution of the issues identified in the report, the W69 nuclear explosive operations will have adequate positive measures to ensure nuclear explosive safety . . . ." However, the report identified numerous issues that were not easy to resolve, including generic issues of continuing safety interest, such as lightning protection, fire protection, seismic analyses, facility selection, and on-site transportation. Lingering concerns with the resolution of W69 issues ultimately led to the issuance of a series of Board letters on the subject. Eventually, DOE agreed on the resolution of the W69-specific issues, and the first Authorization Agreement for a weapon activity was approved. DOE responses addressing broader issues of facility selection criteria, development of a HAR standard, and implementation of the 452-series of DOE orders remain outstanding items at the close of 1997.

3.7.4 W79 Dismantlement Program

The DOE Project Team, a group responsible for developing the W79 Dismantlement Program, took several steps during 1997 toward start-up of the Program. Technical problems were resolved with the design of the ventilation, fire suppression, and temperature control systems for the work stations at which dissolution of high explosives (HE) is conducted. The Board's staff witnessed a W79 Single Independent Readiness Review (SIRR) in June 1997, during which shortcomings with engineering/tooling design, interim hazard analysis, procedural inadequacies, and production technician training were identified. The Board identified these issues to DOE in a letter dated September 5, 1997. Because of the number of prestart findings, a second SIRR was required; it was successfully conducted, and permission was granted by DOE to perform dissolution operations involving mock plutonium, but live HE.

Further observation of the first such operation at Pantex indicated that the production technicians and their supervisors had a good understanding of safety controls and the HE dissolution process. However, during the first dissolution in the new workstation, shortcomings in the procedure were discovered that were attributed to inadequate transfer of lessons learned from process development at LLNL. As a result, further changes in the W79 process were required, as well as physical modifications to the workstation and the tooling; this resulted in considerable program delay.

3.7.5 W78 and W76 SS-21 Surveillance Programs

Stockpile surveillance programs involve the disassembly, inspection, and reassembly of stockpile weapons. Projects at the Pantex Plant for incorporating the Seamless Safety (SS-21)/Integrated Safety Process (ISP) into surveillance activities are in the early stages because DOE had previously concentrated its effort on the large dismantlement efforts that involved older systems. Throughout these early activities, the Board and its staff have concentrated on ensuring that the tenets of Integrated Safety Management are implemented in an effective and efficient manner.

In June 1997, DOE conducted a W76 SS-21 Milestone II Review. The Board's Pantex Site Representatives reported to the Board that, rather than formally reviewing the project and making a determination of readiness to continue, the review appeared to be an "informal staff meeting" for the Project Team. Following discussion with the Board's staff, a more formal review by the W76 Management Team was conducted. It was also recognized that the program had fallen behind the approved planning dates, and a recovery plan was developed. The First Surveillance Unit (FSU) is projected for October 1998.

The Board's efforts to improve the quality of project milestone reviews at the Pantex Plant in order to identify outstanding safety issues more consistently have had a noticeable positive effect. In August 1997, during its observation of the Milestone I Review for the W78 SS-21

Project supporting W78 surveillance, the Board's staff noted that the DOE-Albuquerque (DOE-AL) Assistant Manager of National Defense Programs demonstrated a "demanding customer" attitude, thereby greatly enhancing the effectiveness of the review. The Board believes that continued involvement of senior managers at this level is crucial to the successful incorporation of an integrated safety process into the disassembly, inspection, and reassembly processes of nuclear weapons at the Pantex Plant.

While this Milestone I Review was completed successfully, senior DOE managers identified and discussed several ideas and expectations for enhancing the integrated safety process for nuclear weapons disassembly and assembly. The DOE-AL Assistant Manager recognized that there was a great deal of variation in the understanding and knowledge of guidance contained in EP 401110, *Integrated Safety Process for Assembly and Disassembly of Nuclear Weapons*, among meeting participants, and proposed the development of a program management course to address this problem. In addition, laboratory representatives expressed a strong desire to review and comment on the training lesson plans for the production technicians. In September 1997, the Board sent to DOE its staff's trip report containing observations from this review for use in incorporating these items and other lessons learned into the next revision of EP 401110.

3.7.6 Existing Safety Basis Documentation

The Board has continued through 1997 to find problems with the content and implementation of safety basis controls at Pantex. In particular, reviews by the Board's staff and by a DOE-Headquarters team found inadequate safety analysis and inadequate identification of safety controls in activities in several special-purpose bays. Several nuclear explosive operations, including those in the Linear Accelerator (LINAC) facilities for conducting radiography, in environmental chambers, and in dynamic balancing of weapons, were suspended at the end of 1996 as a result of those reviews.

LINAC

In early 1997, following suspension of LINAC operations, the weapon design agencies (LANL and LLNL) conducted an analysis of the LINAC safety basis. After extended internal debate and discussion with the Board's staff, the design agencies clarified the weapon response information that allowed for development of appropriate controls. For example, after these technical exchanges, the design agencies concluded that dose rate, rather than total dose to a weapon, was a parameter of concern. DOE and its contractors subsequently revised the radiography procedure to include minimum wait times between LINAC operations, controls to prevent potentially dangerous charge buildup, and controls to ensure that actual configuration during radiography was consistent with the analyzed configuration. These controls were incorporated in the Basis for Interim Operations (BIO) and other safety basis documentation. Procedures and training were revised to reflect the new safety controls. The Board closely monitored development of these controls and ultimately agreed with DOE on the results of all LINAC restart preparations and analyses. LINAC operations safely resumed in April 1997.

Dynamic Balancer

The Pantex contractor suspended dynamic balancing operations because of uncertainties associated with the safety basis controls, especially with regard to potential overspeed events. Based on the lessons learned in restarting the LINAC, DOE decided to conduct a preliminary hazards analysis of the entire dynamic balancing operation. DOE chose to address resolution of these safety basis issues using a project team made up of experts from DOE, the weapon design agencies, and the Pantex operating contractor. However, the controls initially selected, as well as specific areas of the analysis itself, were questioned by both DOE-Headquarters personnel and the Board's staff. Ultimately, a 2-day meeting involving DOE-Headquarters, the Dynamic Balancer Project Team, and the Board's staff was held to resolve outstanding questions prior to approval of the Dynamic Balancer BIO. As a result, the Project Team and DOE-Headquarters developed a path forward for completing the BIO and restarting the dynamic balancer, with which the Board concurred in a letter to DOE in October 1997.

With significant involvement of DOE-Headquarters and intensive Board oversight, the project team completed development of a comprehensive set of dynamic balancer controls including both engineered features and procedural controls. In response to the Board's concerns, DOE and the Pantex contractor developed an Authorization Agreement specifying the safety controls and conditions for the operation. An Independent Review Team confirmed readiness to restart dynamic balancing operations. After resolution of emergent issues concerning deficient product-of-inertia fixtures, Pantex safely restarted the dynamic balancer in December 1997.

Additional BIO Development

For several years the Board has reviewed existing and proposed safety basis documents for Pantex operations and identified deficiencies to DOE. In early 1997, DOE and the Pantex contractor also recognized that continued operations under the existing safety basis documentation, especially with regard to the Pantex BIO, were inadequate. Both DOE and the contractor also noted that the approach taken up to that point to improve the safety basis was neither efficient nor effective. With technical input from the Board and its staff, the contractor proposed and DOE accepted a plan to upgrade the BIO on a modular basis, rather than to defer implementation of new controls until extensive analytical work is completed, reviewed, and approved. Initial project teams were chartered to address transportation, nuclear explosive fire protection, and lightning protection. These efforts are continuing into 1998.

3.7.7 Pit Storage

The safety implications of projected long-term storage of plutonium pits are being evaluated by the Board. From an integrated safety standpoint, the pit storage system at Pantex can be viewed as a combination of interrelated barriers to radioactive release (i.e., the pit clad, the container, and the facility), and associated controls needed to maintain those barriers. However, for most pits, the pit clad is the only reliable confinement, since the containers are unsealed and

subject to corrosion and since the current storage facilities lack confinement features. Although DOE, the Pantex Plant contractor, and the design laboratories have been proactive in several areas to ensure pit integrity, there are no Technical Safety Requirements related to pit integrity, even though three pit designs have been identified with achievable temperature-driven failure modes. In addition, there is no formal program to explore the possibility that excess pits may undergo corrosion to the extent that containment of the plutonium might fail, even though the current pit storage environment is possibly conducive to clad corrosion.

During 1997, the Board and its staff completed a detailed review of DOE efforts in this area, which is described in DNFSB/TECH 18, *Review of Safety of Storing Plutonium Pits at the Pantex Plant* (November 25, 1997). DOE has initiated several programs to ensure continued safe storage of pits; however, some deficiencies in the overall pit storage system have never been fully addressed, and some activities appear to achieve short-term goals without fully considering the long-term implications. Many of the issues raised can be addressed properly only by applying a systems approach.

For example, DOE has planned for some time to repackage pits in a new AT-400A container that would prevent pit corrosion, provide rugged mechanical protection during storage, and compensate for the lack of authorization basis controls for pit integrity. The AT-400A, a modified version of the DOE-designed AT-400R Russian fissile material container, was promoted as a possible answer to several safety issues. However, at the rate of packaging 20 pits per month (scaled down from original projections of 2000 pits per year), it would take decades to repackage all the pits at Pantex in these containers.

During 1997, the Board's staff observed the successful completion of a DOE Operational Readiness Review of the repackaging process using the AT-400A containers. Observations were provided in the Board's letter to DOE of October 9, 1997. DOE has now begun to repackage the most limiting pits from a safety standpoint in these containers. However, progress is slow because of welding and weld inspection difficulties, as well as a recent decision to replace the repackaging line with a more automated line. Furthermore, because of the high production cost, DOE appears to be scaling back this program so that only one type of pit may be so packaged, at least for an interim period. To compensate, DOE has initiated an effort to improve the existing containers, but this move started with weak coordination and has lacked complete definition of requirements, including safety requirements. Additionally, it is not clear how these container decisions have impacted plans to perform surveillance of pits or plans for new storage facilities (e.g., Building 12-116).

In early 1997, DOE decided to consolidate the storage of more than 10,000 non-strategic-reserve pits into an existing warehouse at the Pantex Plant. This decision was driven by a possible reduction in operational costs, but the decision was made without a systematic review of design and safety requirements. The consolidation could have resulted in a Pantex facility being used to store the largest plutonium inventory in the DOE complex, but in the Board's opinion, the chosen facility was clearly not adequate. Subsequently, significant safety questions raised by the Board

and other issues emerged regarding this consolidation, and in late 1997, DOE discontinued this effort.

Throughout 1997, the Board's staff was actively engaged in discussions with DOE, during which they reviewed all of the safety issues with DOE and its contractors and focused high-level management attention on these issues. Substantial improvements followed. For example, the weapon design agencies issued a draft pit storage specification that is intended to minimize pit corrosion and is likely to require that the pits be stored in sealed containers. The latter would provide a second barrier to release of plutonium during postulated accidents. Furthermore, DOE decided to improve the existing facilities that are being used for interim storage of surplus pits (i.e., the Zone 4 magazines). Under the impetus of Board review, DOE committed to develop an integrated pit storage program plan. This should lead to a logical development of requirements and to increased high-level attention for pit safety issues. The Board plans to continue to monitor these developments. The topic of safe storage of these pits is one of the most important subjects of the Board's attention.

3.7.8 Lightning Protection

After conducting several on-site reviews in 1996 and 1997, it became clear to the Board that the potential hazards that lightning posed to nuclear explosive operations had not been as comprehensively and consistently addressed at the Pantex Plant as was merited. One issue raised in an SNL report was the estimation of the amount of electrical energy induced by a lightning strike that would create a likely threat environment inside all bays and cells. The SNL report documented that this threat environment to nuclear explosive operations could be minimized if the facility rebar was bonded sufficiently (ceiling, walls, floor, and all penetrations) such that the enclosure could be treated as a Faraday cage—a metallic enclosure (either external or internal to a facility) that when properly grounded serves as an effective lightning protection mechanism. However, as a result of continuing investigations, spurred in part by the Board's focus on the W69 dismantlement activity, DOE determined that in both Building 12-60 and Building 12-44, the rebar in the floors was isolated from the wall rebar, and in Building 12-64, the ceiling rebar is not continuous because of the cantilevered roof system. These existing facility design conditions raised issues with the Faraday cage model described in the SNL report.

A second issue identified through a review by the Board's staff was that the surveillance intervals for visual inspection and electrical testing of the existing lightning protection system at the Pantex Plant exceeded the maximum allowed by National Fire Protection Association (NFPA) code. This situation could allow a problem to go undetected for a longer period of time than commercial standards specify. Furthermore, Pantex had been experiencing additional problems with the lightning warning system. Although specific facility/program actions are required upon receipt of lightning warnings, and credit is taken for these actions, the lightning warning system is not formally incorporated into Pantex safety documents. Thus, there were no measures directed to be taken upon loss of the lightning warning system, and in fact, on at least two occasions the loss of the system went unrecognized.

In September 1997, the Board requested that DOE prepare a detailed technical report providing a comprehensive analysis of the hazards posed by lightning to nuclear explosive operations, the controls necessary to prevent and mitigate those hazards, the controls currently in place, and the path forward for implementing and preserving the controls needed. At DOE's request, the Board has agreed that this report is to be completed by February 20, 1998.

In developing the analysis required to prepare this report and in responding to deficiencies identified by the Board and in its own internal reviews, DOE identified and installed many additional protective measures that should render nuclear explosive operations at Pantex less vulnerable to threats from lightning. These protective measures include electrically bonding metallic penetrations into the bays and cells, installing surge protectors on electrical lines going into the bays and cells, and certifying certain nuclear explosive transportation containers as providing protection for lightning-induced hazards. Other protective measures being considered by DOE would further enhance the safety of nuclear explosive operations at Pantex. The Board's staff is closely monitoring the facility improvements currently being made at Pantex, as well as the efforts of the DOE project team assigned to prepare the technical report. The Board and its staff plan to continue to work closely with DOE to ensure that the lightning hazard to nuclear explosive operations is adequately addressed.

3.8 Y-12 PLANT

The Y-12 Plant, near Oak Ridge, Tennessee, has been identified by DOE as part of the enduring nuclear weapons complex and is designated as the site for conduct of the secondary and case fabrication mission. This mission includes fabrication, surveillance, inspection, and testing of weapons components. Activities include operations to process, machine, inspect, assemble, and disassemble such materials as depleted uranium, enriched uranium, uranium alloys, isotopically enriched lithium hydride and lithium deuteride, and other materials. The Board has focused significant resources and attention on reviewing safety-related matters at the site. Most recently, the Board's actions at the Y-12 Plant have focused on DOE's preparations to restart the various nuclear activities subsequent to the contractor shutting them down in September 1994. The Board's actions relative to the Y-12 Plant in 1997 were a consequence of events in prior years, described below.

During a routine site review in September 1994, members of the Board's staff observed several violations of nuclear criticality safety limits in storage vaults at the plant and brought these violations to the attention of contractor management and the DOE Facility Representative. Neither the DOE nor contractor personnel present took the actions required by the applicable criticality safety procedure until after members of the Board's staff notified DOE's Y-12 Site Office Manager. As a result of these violations, contractor management curtailed Y-12 activities and began a comprehensive site-wide walkdown of requirements to prevent a nuclear criticality. This review disclosed 1,344 instances of nonconformance with requirements. Because of these findings and other safety-related issues that had been noted during visits by the Board's staff

during the previous 2 years, the Board issued Recommendation 94-4 in September 1994, calling on DOE to evaluate and improve performance at the Y-12 Plant in criticality safety, conduct of operations, and training of contractor and DOE personnel involved with plant operations. Significant improvements in these areas have taken place during the past 3 years as a result of initiatives undertaken by DOE in response to Recommendation 94-4.

Although nuclear operations were effectively shut down in September 1994 in response to Board concerns, DOE and its contractor, Lockheed Martin Energy Systems (LMES), put in place a process by which Y-12 would continue to support urgent national security requirements while continuing to ensure worker and public safety as well as protection of the environment. This involved the contractor initiating and DOE approving Special Operations Packages—processes by which work was scoped, hazards assessed, and controls and compensatory measures identified and implemented. This allowed the undisturbed continuation of the nuclear weapons dismantlement, the receipt of more than 600 kilograms of highly enriched uranium from Kazakhstan in the highly successful "Project Sapphire," and the continuation of the Y-12 mission to provide surveillance data on the nation's enduring nuclear stockpile, among other initiatives.

Activities since September 1994 have focused on restarting various sections of Y-12. The receipt, shipment, and storage function and depleted uranium operations were reviewed and restarted in September 1995. Quality Evaluation (QE, surveillance) operations were restarted in October 1995, and the Disassembly and Assembly Facility was assessed and approved for operations in March 1996. Enriched Uranium Operations (EUO), the only area that remains to be restarted, is scheduled to begin in 1998, and is likely to be the most complex and hazardous restart attempted by LMES and the Y-12 organization.

3.8.1 Enriched Uranium Operations Restart

Operations under the restart plan for EUO started in October 1996 and are scheduled to be performed in phases during 1998 and 1999. The restart dates for EUO were selected to support a critical national security requirement. During the shutdown described above, initial efforts were focused on other facilities. As the restart plan was defined in late spring and early summer 1996, a schedule was established, culminating in a two-phase restart. The current restart schedule calls for Phase A (metal casting, rolling, forming, and machining) to be completed in April 1998, and Phase B (metal recovery, chemical processing, and production) in February 1999.

During 1997, the Board's staff had numerous meetings with DOE regarding restart activities. Board members visited the Y-12 Plant, and LMES and DOE personnel traveled to Washington to brief the Board. In addition, the Board's staff performed a significant number of functional area safety reviews at Y-12 throughout 1997.

Staff reviews in early 1997 led the Board to conclude that the EUO restart effort was not on a successful path and that DOE and LMES leadership did not recognize this fact. Hazards analyses and identification of safety controls were falling further and further behind schedule, and

Y-12 was unlikely to be ready to start up safely on a timely basis. The Board brought these issues to the attention of senior DOE management, and after DOE validated the problem, leadership changes were made, and significant senior DOE management attention was brought to bear on the issue. The schedule was significantly improved, and safety is now being addressed in a more rigorous and comprehensive manner. The Board and its staff continued to identify safety issues that were not being aggressively pursued by DOE and LMES. These included such issues as fire protection, electrical systems, implementation of safety controls, dismantlement, and maintenance and surveillance activities. These issues are discussed in the following sections.

Fire Protection

During the walkdowns associated with a review by the Board's staff, it became readily apparent that the EUO complex had an unnecessarily high combustible loading, which constituted a potential fire hazard. This deficiency, when combined with the large amount of excess "in-process" fissile material in the EUO complex (discussed later), created an unnecessary increase in risk. The situation was so significant that for more than a year, a fire watch had to be established in Building 9212 as a compensatory measure. In response to continued pursuit of this issue by the Board's staff, LMES and DOE attacked the issue aggressively and removed significant amounts of unnecessary combustible material. The Board believes that DOE needs to give more attention to this threat.

Electrical Systems

During a staff review, it was noted that an old motor control center and its associated conduit systems were severely corroded, showing significant age-related degradation. It was clear that these components had exceeded their useful life. The potential unavailability of the fire protection system served by this equipment, coupled with the possibility of fire initiation and propagation directly from the equipment, created a significant hazard. After the Board pointed this out, funding to replace the motor control center was programmed for 1998.

In March 1993, five transformers in the complex had failed, bringing the total number of failed transformers from a single vendor to 9 (of 52 installed during 1987 and 1988). Moisture contamination, poor-quality construction, and a lack of space heaters appear to have been the primary contributing causes of the failures. During a review by the Board's staff in November 1993, DOE presented its plan for replacing all 52 transformers, but the plan was never implemented, despite the fact that replacement transformers had been on hand for a considerable period of time. After the Board expressed its interest in this matter during 1997, the transformers were replaced.

Implementation of Safety Controls

In the latter part of 1997, the Board's staff conducted a comprehensive review of implementation of specific safety controls defined in the relevant safety basis for the Building

9212 complex. In one case, a single relay of unknown reliability was found to actuate several safety functions; a failure of this one component could undermine several safety systems at once. In another example, operators were expected to take certain mitigative actions in given situations, but the training provided to the operators did not identify those situations or provide guidance on the expected actions.

This review identified several deficiencies that led the Board to conclude that some safety controls in the facility could not be adequately assured. After the Board and its staff made these deficiencies known, DOE and LMES committed to take steps to improve their own self-assessment capabilities and to evaluate the specific actions required to address the deficiencies identified. These corrective actions are scheduled to be monitored by the Board and its staff as they are implemented during the coming months.

Although a number of technical and management challenges were identified throughout the year, an effective working relationship between the Board and DOE has resulted in keeping restart activities for this hazardous operation relatively close to their planned schedule while maintaining an appropriate level of emphasis on safety issues. The Board anticipates that this relationship will continue and thus help ensure the safe and timely restart of EUO.

Dismantlement Activities

Dismantlement activities at the Y-12 Plant continue at an impressive pace. The staff at the plant dismantled 30 percent more weapons secondaries than were scheduled to be dismantled for 1997, thus removing a portion of the backlog of older secondaries. LMES management credits this impressive performance, in part, to the more rigorous formality of operations program that has been instituted as a direct consequence of the September 1994 shutdown and Board Recommendation 94-4.

Maintenance Program

When the Board assessed the Y-12 maintenance program early in 1997, it appeared that correcting the deficiencies with the program would be one of the most difficult and time-consuming aspects of EUO restart. Both the site-wide and EUO-restart-specific maintenance programs were significantly deficient. The Board's emphasis on this subject was influential in focusing the attention of LMES management on this area, and maintenance programs have improved significantly.

Surveillance Activities

Unrestricted surveillance activities were restarted in the spring of 1997, and LMES was able to meet its schedule of disassembling 15 units and issuing 10 reports during the year. Increased rigor and formality were effectively applied to these activities also, and LMES was able

to implement the appropriately tailored level of rigor and formality successfully without delaying the work.

3.8.2 Nuclear Facilities and Material Remaining from Production Operations

The Board has given considerable attention to the safety implications of special nuclear materials that remain from the former weapons production program. In a February 1996 letter forwarding a technical report to DOE, the Board asked DOE to describe actions that would be taken to characterize and catalogue excess highly enriched uranium (HEU) residues, and to establish priorities for processing these residues when enriched uranium operations are restarted at the Y-12 Plant. In a report and associated briefings provided to the Board, DOE identified more than 100 metric tons of excess special nuclear material from enriched uranium operations at Y-12, a significant fraction of which is stored in Building 9206.

Building 9206 is a facility with significant amounts of material at risk. It is vintage 1943 steel-frame construction with hollow clay tile in-fill. The 64,000 ft^2 facility is about 400 meters from the site boundary and is presently in a stand-down operational status. The original mission of the building was recovery of a wide range of enrichments of HEU, but the current use is limited to storage of excess “in-process” fissile material awaiting processing. This consists of more than 2,600 batches of uranium-bearing material in several forms and various enrichments; they include metals, oxides, compounds, combustibles, residues, solutions, and ventilation duct holdup. The total net weight of the material is estimated to be 20,000 kg with approximately 3,200 kg of uranium-235. The material, packaged in cans, vessels, drums, plastic bags and containers, is located throughout the facility in vaults, piping, hoods, and tanks. There are no plans to restart the facility. There are also no funded plans to begin its transition to decommissioning.

Many vulnerabilities in the facility have been identified by both the Board’s staff and DOE's HEU Vulnerability Assessment. In response to a Board reporting requirement in 1996, LMES had provided a plan that outlined what it would take to process the material at risk in the facility. However, at current funding levels, much of the material cannot be processed. In fact, it is liable to take many years to process even the least stable materials—those most at risk. DOE has rated the facility as one of its four most vulnerable HEU facilities in the entire complex.

In 1997, the Board reviewed DOE's progress toward reducing the vulnerabilities identified in the building, as well as reducing the material at risk. Although some progress was made in removing combustibles from the facility, little progress has been made toward bringing the facility into a safer condition. There is a perceived lack of urgency for activities associated with Building 9206. The Board plans to continue to review issues related to deactivation and decommissioning activities in the building to assess BIO, phaseout plan, remedial activities to address documented vulnerabilities, and operation of the recovery furnace.

3.9 NEVADA TEST SITE

Underground testing of nuclear weapons is no longer being conducted at NTS. However, this site continues to play an important role in DOE's actions to ensure the safety and reliability of the nuclear weapons stockpile in the absence of weapons testing. Activities currently being conducted at NTS that are, by law, safety responsibilities subject to oversight by the Board are the subcritical experiment program and preparations for startup of the new Device Assembly Facility (DAF).

3.9.1 Integrated Safety Management of Subcritical Experiments

DOE's program of subcritical experiments is a vital materials research component of its Stockpile Stewardship and Management Program. Subcritical experiments involve devices containing both HE and special nuclear material, and thus they are inherently hazardous. The experimental configurations are designed, however, to prevent nuclear criticality, much less a nuclear explosion.

The Board has extensively reviewed DOE's and the weapons laboratories' safety planning for the operations associated with the subcritical experiment program. During these reviews, the Board and its staff have examined the containment design, hazards analyses, and other safety basis documentation developed for the first two experiments. The Board's staff has also discussed with the Nevada Operations Office and DOE-Headquarters the Board's expectations for an appropriate Integrated Safety Management program for future experiments.

The Board had stated in a 1996 letter to DOE its concern that there did not seem to be a well-defined plan for the Integrated Safety Management of subcritical experiments, or any apparent expectation for the development of such an approach. In response to the Board's concern, DOE provided adequate hazard analyses; the resulting safety management plans were also adequate for the relatively low hazards involved in the first two proposed experiments. However, the Board had urged DOE to develop a comprehensive ISM plan to address the full range of hazards associated with future subcritical experiments.

The Board is pleased to note that, in 1997, DOE-Nevada developed two orders outlining DOE's expectations for the integrated safety management of the subcritical experiment program. One of these orders was formally issued in 1997. The Board expects that, when fully implemented, this program will provide the detailed guidance necessary to address all future experiments, grading the safety management approach appropriately to the risk associated with the activity.

In 1997, DOE successfully and safely conducted the first two subcritical experiments at NTS. The first experiment, REBOUND, was executed by LANL in July 1997. The second experiment, HOLOG, was executed by LLNL in September 1997. As the discussed in the Board's letter acknowledging DOE's safe execution of the HOLOG experiment, the Board plans

to continue to monitor the implementation of Integrated Safety Management for all future subcritical experiments. The Board expects various issues raised during the past year, such as the adequacy of emergency response during subcritical experiments and the quality of construction documents, to be addressed as part of the implementation. The Board's review of the first experiment, STAGECOACH, to be conducted under the new Integrated Safety Management program began in 1997 and is to continue into 1998, when the experiment is scheduled to be executed. The Board's initial evaluations of the hazard analysis, controls development, and independent safety evaluations resulting from implementation of DOE-Nevada's new Integrated Safety Management program indicate that there have been significant improvements compared with the past; however, more needs to be done. The Board continues to place priority on ensuring that these experiments important to national security are conducted safely.

3.9.2 Device Assembly Facility Startup

The DAF is a new facility for nuclear explosive operations that is expected to start up early in 1998. This facility is intended to support activities related to nuclear test readiness and science-based stockpile stewardship, including assembly of subcritical experiments. The DAF is distant from population centers and has very few collocated workers. This reduces the consequences of potential accidents. Also, by design, the facility provides significantly enhanced safety and security as compared with older assembly facilities on the site.

The Board has monitored preparations for initial operation of the DAF. As discussed in a Board letter to DOE in April 1997, the facility has many elements of a satisfactory Integrated Safety Management program, but some improvements are possible. For example, the systematic addressing of activity-specific hazards requires additional improvement. The Board continues to monitor overall progress toward the facility's operational status, including resolution of findings from the DOE Operational Readiness Review conducted in November 1997 and from earlier reviews.

3.10 LOS ALAMOS NATIONAL LABORATORY

LANL, located in northern New Mexico, is the DOE weapons laboratory with the largest number of defense nuclear facilities and the most weapons-related activities. It is the main site for ongoing R&D into means of certifying the safety and reliability of nuclear weapons in the absence of nuclear testing. It is also to be the location of DOE's limited-scale manufacturing capability for replacement nuclear weapons pits.

In the early 1990s, when the Board began oversight of LANL, the laboratory was operating in an informal manner with regard to safety. Proposed work activities, whether research, development, testing, demonstration, or limited-scale production, were typically not subjected to rigorous hazards analyses and to reviews to determine whether performing the work within a given facility was within the safety basis for that facility. Typically, there were few

controls to ensure that work was performed safely, in accordance with a formally structured, authorized protocol. In addition, there had been several serious accidents at LANL.

Subsequent to numerous Board staff reviews and Board letters, LANL has made significant progress in improving safety management. At a site-wide level, a formal but flexible Integrated Safety Management System is being developed. At a facility level, the Plutonium Facility (TA-55), currently the location of most plutonium processing at LANL, has made significant progress in formalizing operational safety. In its evolution toward better safety management, laboratory management at TA-55 suspended operations for nearly 3 months at one point while improved safety management procedures were developed. In response to the Board's focused attention, operations and maintenance at TA-55 have been improved, to help ensure that work is performed in a safe and controlled manner that is tailored to the hazards and importance of the operation. These hazards are identified by using a methodical process that comprehensively considers the risks to workers, collocated workers, and the public; TA-55 now has a workable safety management program. The director of LANL recently stated that productivity at TA-55 has increased dramatically in the last 2 years. He also noted that experience at TA-55 has shown that working in a formal, deliberate fashion and following reviewed and approved procedures that are tailored to the hazards led to improved efficiency, productivity, and safety.

While oversight is continuing at TA-55 to ensure that R&D activities receive appropriate hazard analyses before work begins, the Board's focus at LANL has shifted somewhat to upgrading of facilities and to safety management at the Chemistry and Metallurgy Research (CMR) building, as discussed below. CMR's main function is chemical analysis and small projects involving uranium.

3.10.1 Facility Upgrades

A number of facilities at LANL are undergoing major upgrades to structures and other physical infrastructure, including safety systems and processing equipment. They include the Capability Maintenance and Improvement Project (CMIP), and upgrades of CMR, the Nuclear Materials Storage Facility (NMSF), and the water supply system for fire suppression at TA-55. The designs for upgrades of facilities at LANL are affected by the need to address hazards from natural phenomena, particularly earthquakes. These improvements, as well as other pertinent topics, are discussed in the following sections of this report.

Geologic and Seismic Hazards

There are three geologic faults of particular interest near LANL, namely, the Pajarito, Rendija Canyon, and Guaje Mountain faults. Two geologic studies related to the potential for earthquakes are still ongoing. One study, trenching at the Pajarito fault, is intended to better define the basis for seismic design at LANL and is expected to be completed by early 1998. The second study, encouraged by the Board, maps the continuation of the southern end of the Rendija Canyon fault. The results of the Rendija Canyon study have confirmed that the fault does not

extend beneath TA-55. However, the study provides evidence that the Rendija Canyon fault splays to the southwest toward TA-3, where the CMR building is located. DOE has requested that LANL review the implications of the results of the study for the use of CMR for the CMIP. The Board's staff continues to review the safety implications of the results of these studies.

Capability Maintenance and Improvement Project

The CMIP is a major design and construction project at LANL. It has as objectives the development of the capacity for limited-scale manufacturing of plutonium pits for nuclear weapons and the improvement of the capability to carry out current and planned future missions by maintaining and improving facilities. As originally envisioned, the CMIP was to involve TA-55, CMR, and some non-nuclear facilities and infrastructure, but in late 1997, DOE revised the schedule for CMIP and decided not to use CMR for the project. During 1997, the Board conducted several reviews of safety issues associated with the design and construction of CMIP.

Nuclear Material Storage Facility

The NMSF was constructed in 1987 for storage of plutonium at LANL. Because of errors in design and construction, it has never been used for handling and storing special nuclear material. NMSF is undergoing a redesign, resulting in substantial modification. Recent reviews of NMSF by the Board and its staff have focused on strategies for ensuring that temperature limits for the safe storage of plutonium and pits can be met with adequate safety margins because of the inherently low thermal margin of the proposed natural draft ventilation system.

Presentations by LANL on thermal modeling and experimentation indicate, at least preliminarily, that operation below the thermal limits for both normal and accident conditions may be achievable using the proposed passive cooling system of the vault. However, additional, rigorous analysis and experimentation are expected to demonstrate that the temperature limits can be satisfied. The Board recognizes the complexity of the thermal design question and other issues, and has focused its review activities on the design process and a configuration management plan to control that process.

TA-55 Fire-Suppression Water-Supply System

The current fire-suppression water-supply system at TA-55 is severely rusted and probably would not withstand the loading induced by the design basis earthquake (DBE). Planned upgrades of this system include installing new underground piping and seismically retrofitting two existing pump houses and associated water tanks. During reviews of the planned upgrades, the Board's staff observed several significant deficiencies in the fire-suppression system related to the design for earthquake loading. The design now appears to be addressing these deficiencies.

3.10.2 Chemistry and Metallurgy Research Facility Operations

The Board continued to urge DOE and LANL to improve facility management at the CMR as has been done at TA-55. As part of a review whose primary focus was CMIP, the Board highlighted its staff's observation that the ability of the management of the CMR facility to support adequately the safety upgrades necessary for the CMIP was problematic. During reviews of CMIP by the Board's staff during 1997, facility management personnel at CMR displayed limited knowledge of the facility's current authorization basis. In addition, safety training of CMR's facility management personnel was weak compared, for example, with that of TA-55 managers. Consistent with observations by the Board's staff, DOE's Los Alamos Area Office (LAAO) noted that the CMR Facility Manager was approving Unreviewed Safety Question Determinations without any formal training, contrary to requirements of DOE Order 5480.21, *Unreviewed Safety Questions*.

After discussions with DOE/LAAO on these and related topics, LANL management decided to suspend operations at CMR temporarily to review safety management and training. Two subsequent reviews of CMR safety management by the Board's staff disclosed that the CMR facility suffered from years of relative disregard for its authorization basis. Deficiencies were evident in the authorization basis documentation that identifies and analyzes safety-related equipment, equipment maintenance, and configuration control for the equipment. As a consequence, effective work control and work authorization were unnecessarily complicated. In addition, significant deficiencies existed with much of the infrastructure, such as maintenance, surveillance, issues management, and hazard assessment.

While CMR operations are suspended, LANL is improving in all these areas and taking appropriate compensatory actions, in many cases at the direction of DOE/LAAO, to strengthen implementation of the authorization basis. In December 1997, LANL announced a reorganization assigning the responsibility for management of CMR to the Nuclear Materials Technology Division, which manages TA-55. Additionally, there is an intensive effort to develop a BIO and new Technical Safety Requirements by mid-1998. The Board and its staff continue to work with DOE in resolving these safety issues.

3.10.3 Hydrodynamic Testing

Hydrodynamic tests are experiments for studying the performance of nuclear weapons components, typically conducted on mockups of weapons components and on simplified structures in specially designed vessels. LANL is planning a series of such tests to compare the performance of aged weapons components with that of new ones. Because of potential hazards, LANL and DOE prepared a separate Safety Analysis Report and related documentation to cover the series of tests. The Board reviewed these documents and evaluated requirements for the vessels. Subsequent to these reviews, significant improvements were made in the quality of the hazard and risk analyses and in the identification of controls to reduce risks. The Board and its

staff plan to continue to monitor this activity and the planned Operational Readiness Review, to verify that rigorous controls are in place before testing proceeds.

3.11 LAWRENCE LIVERMORE NATIONAL LABORATORY

LLNL, located in northern California, is a nuclear weapons laboratory with an ongoing mission in DOE's Stockpile Stewardship and Management Program. LLNL is currently the site of nuclear materials and weapons research and development, and is projected to be the location of a major new Stewardship project, the National Ignition Facility.

3.11.1 Work Control Problems at the LLNL Plutonium Facility

LLNL has made safety improvements at the Plutonium Facility, Building 332, during the past few years; however, deficiencies with work planning and control have been persistent. After the Board issued a letter to DOE in 1995, noting the absence of facility operating limits and failure to meet surveillance requirements in the Plutonium Facility, LLNL suspended operations, revised the facility's Safety Analysis Report, rewrote many of the Technical Safety Requirements, and performed a formal restart process later that year. The Board wrote to DOE again in 1996, identifying problems with work control, Integrated Safety Management, and the LLNL criticality safety program. LLNL and DOE have significantly improved the program during the past 2 years, but, as described below, reviews by the Board's staff in 1997 and assessments of criticality infractions that occurred in the Plutonium Facility last year revealed that work control at the LLNL Plutonium Facility still lacks adequate formality, supervision, and oversight.

Two nuclear criticality infractions in Building 332 were reported by LLNL in July and October 1997. LLNL analysis of the infractions identified numerous related criticality infractions, involving problems with (1) lines of responsibility and supervision for the work performed, (2) training for the work being performed (specifically criticality), (3) inadequate hazards control, and (4) oversight of the work. These represent significant breakdowns in safety management.

In December 1997, the Board's staff reviewed the criticality infractions and subsequent laboratory and DOE assessments, and identified corrective actions. This review indicated that there had been insufficient root-cause analysis to support the corrective actions, that corrective actions had not been implemented, and that operations were being performed without complying with compensatory measures that had been identified. The Board's staff also noted other operational deficiencies. These included overreliance on mass controls that were known to be ineffective, poor integration with firefighting requirements, and poor quality control of criticality safety evaluations. Criticality safety personnel did not appear to have a presence in the work place. The Plutonium Facility had a clear overall problem with work planning, work authorization, and formality of operations, yet at the end of 1997, the planned corrective actions did not address these problems.

In addition, the review by the Board's staff suggested that there was insufficient DOE oversight in the Plutonium Facility. DOE had not recognized months of criticality infractions or poor work planning and supervision. It also did not appear that DOE had communicated adequately its expectations for resumption and approval of work at the Plutonium Facility.

On December 31, 1997, the Board sent a letter to Secretary Peña characterizing the deficiencies identified in Building 332 as indicators of a basic problem with the interim Integrated Safety Management program. The Board stressed that the current DOE-Oakland and LLNL performance measure-based safety management approach needs to be brought into line with the DOE policy on Integrated Safety Management, which is predicated on prework planning in accordance with prescribed practices to establish safety measures tailored to the hazards of the work. The Board observed that there was no apparent effort by DOE-Oakland to develop a corrective action plan for its own involvement in and contribution to the current situation. In the Board's opinion, this raises questions as to whether DOE-Oakland is staffed with the technical capabilities necessary to provide guidance to LLNL and to act as an effective demanding customer for Integrated Safety Management issues.

The Board continues to monitor DOE and LLNL implementation of their corrective action plans, as well as the phased resumption of operations at the Plutonium Facility, in order to ensure that work planning, work authorization, and work oversight are consistent with the principles of Integrated Safety Management.

3.12 SANDIA NATIONAL LABORATORIES

SNL is a DOE weapons laboratory with major sites at Albuquerque, New Mexico, and Livermore, California. SNL provides ongoing R&D and technical expertise to support stockpile stewardship and management, and plays an active role in the assembly, disassembly, and surveillance of all developed nuclear weapons. The principal SNL defense nuclear facilities are in Technical Area V at the Albuquerque site. These include the Annular Core Research Reactor (ACRR), the Hot Cell Facility (HCF), and the Sandia Pulsed Reactor Facility (SPRF). Additional facilities include the Manzano and other nuclear material storage facilities, the Neutron Generator Facility, and the Radioactive and Mixed Waste Management Facility. It is noted that the ACRR and HCF are being readied for use in producing medical isotopes for nondefense purposes under the direction of DOE's Office of Nuclear Energy, Science, and Technology. ACRR's capability to support emergent defense needs is to be maintained as a contingency.

In early 1997, the Board forwarded to DOE the results of a review by the Board's staff of SNL's self-assessment program. This review indicated that SNL's self-assessment program was not sufficiently effective at identifying safety deficiencies. SNL lacked an adequate process for reviewing, assimilating, and communicating safety deficiencies, their root causes, and lessons learned throughout the site. Local DOE personnel were not being allowed necessary access to SNL's self-assessment reports and other documentation. Subsequent to the staff's review, DOE

canceled plans for reducing its oversight at SNL. In response to the Board's review and subsequent independent DOE reviews with similar findings, DOE's line management is working with SNL to improve its self-assessment program to allow cutback of DOE's surveillance activities (see Section 2.2.6).

3.13 SAVANNAH RIVER SITE

SRS has a vital defense role with its capability to replenish certain weapons components with tritium gas and to process and store the gas. Tritium is a radioactive isotope of hydrogen used in the nation's nuclear weapons. It has a relatively short half-life (12.3 years) and must be replaced periodically in order for the weapons to function as designed. Tritium was last produced in the K-Reactor at SRS, which was shut down in 1988. Currently, DOE does not have the capability to produce tritium. At this time, DOE is pursuing a dual-track strategy involving initiation of work on two promising tritium production options (see also Section 2.5.2): (1) use of an existing commercial light water reactor and (2) construction of a linear accelerator. SRS has been selected as the preferred location for an accelerator, should one be constructed. Under either alternative, new processing facilities to extract the tritium from reactor targets or from accelerator-irradiated targets are planned for construction at SRS. Close attention to ongoing and planned work at the SRS tritium facilities is important to the Board.

3.13.1 Non-Nuclear Reconfiguration

The Board has dedicated substantial time and resources to overseeing the safety aspects of the installation and startup of new tritium activities associated with the Non-Nuclear Reconfiguration (NNR) program. Under the NNR program, the tritium reservoir development and testing mission has been transferred from the Mound Laboratory to SRS. The new projects at SRS that support this mission are the Reservoir Surveillance Operations (RSO) and the Gas Transfer Systems (GTS). The RSO verifies the reliability and safety of tritium reservoirs. It includes environmental conditioning, functional testing, burst testing, and analysis of the results. The GTS supports development of special tritium reservoir systems and includes loading, functional testing, gas analysis, tritium recovery, and storage life.

Many of the activities associated with NNR are new to SRS, and in some cases they introduce hazards significantly different from those that are presently associated with the facilities where they are to be housed. For example, the purpose of the environmental conditioning chambers is to subject the reservoirs to the conditions they may experience during usage. The chambers develop a significant amount of mechanical energy that could damage a reservoir, thereby releasing, and possibly igniting, its contents.

The Board has reviewed the systems design and safety analyses associated with NNR. In response to issues raised by the Board regarding the likelihood and consequences of explosion accident scenarios associated with the Environmental Conditioning Chambers, DOE has

significantly improved the safety analyses and supporting documentation to provide a stronger safety basis for operating these chambers.

In addition to its ongoing review of tritium work at SRS, the Board reviewed a new reservoir loading line that will support the loading of strategically important systems in the current stockpile, as well as new reservoirs. This project involves the installation of new equipment and modification of existing equipment within a loading line at Building 233-H, the Tritium Loading and Unloading Facility (formerly the Replacement Tritium Facility), that had not been operated previously. The line is scheduled for start-up in early 1998. Prior to radioactive operations, the Board intends to review DOE's and the contractor's readiness to operate the new line safely.

3.13.2 Consolidated Tritium Safety Analysis Report

A consolidated Safety Analysis Report (SAR) that will combine safety basis documentation for all the SRS tritium facilities into one report is being prepared. The combined SAR and a single, unified set of Technical Safety Requirements (TSRs) are being developed in accordance with current DOE orders and standards. The current SARs and Operational Safety Requirements (the predecessor to TSRs) vary greatly among the tritium facilities. For example, the SAR for the Tritium Loading and Unloading Facility (formerly the Replacement Tritium Facility), which began operation in 1993, is significantly more detailed than the safety basis documents for all other tritium facilities.

The Board is currently engaged in the review of draft versions of the consolidated SAR and TSRs. The Board plans to provide formal commentary, as necessary, to ensure that these documents establish an acceptable safety basis for all the tritium facilities. In addition, the Board intends to review the use of the new TSRs.

3.13.3 Tritium Storage

Future plans for Board oversight of tritium work include the review of a project designed to provide the modernization of tritium processing at SRS and its consolidation into buildings 233-H, 249-H, and the newer portions of 234-H. This involves moving tritium operations out of the 40-year-old 232-H building and most of the older portion of 234-H, where reservoir loading and unloading formerly took place. The project is intended to improve the safety of operations, reduce environmental releases, and reduce operating costs. The project is also intended to provide the capability to process extraction and waste gases from the Tritium Extraction Facility (TEF) and extraction gas from the Accelerator Production of Tritium (APT) facility. The Board intends to review the design, construction, and testing of these facilities. The project is scheduled to be completed in April 2004.

Building 217-H houses a large number of filled tritium reservoirs and hydride storage vessels. The Board called DOE's attention to the possibility that certain natural phenomena (particularly a large earthquake) could cause the building to collapse, potentially releasing a very

large quantity of tritium. As a result, highly invulnerable encased safes (HIVES) have been installed in Building 217-H. These HIVES are designed to maintain their structural integrity in the event of structural collapse of either the building or an adjacent stack. Installation of the HIVES has been completed, and all reservoirs and hydride storage vessels in Building 217-H should be located in the HIVES by early 1998, significantly reducing the risk associated with tritium storage.

The Board also identified the vulnerability of Building 217-H to internal fires with the potential to release large amounts of tritium, and pointed to the need for upgrading fire protection measures within the vault. In response to the Board's concerns, DOE has mitigated the fire hazards by enhancing the Combustibles Control Program, by isolating the vault's air system from the adjoining building, and by enhancing surveillance to ensure that temperatures within the vault are maintained in a safe range.

3.13.4 Tritium Loading and Unloading Facility

The Board continued to follow activities at Building 233-H, the Tritium Loading and Unloading Facility, which was formerly known as the Replacement Tritium Facility. The Board's staff found that Building 233-H has been aggressively pursuing implementation of the principles of Integrated Safety Management. Building 233-H is now operating with an effective safety management program that includes enhanced work planning for ensuring worker protection during maintenance and operations, and a self-assessment program that provides feedback for continuous improvement. Many of the programs that have been effective at Building 233-H are being used at other facilities at SRS and throughout the defense nuclear complex.

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4. HAZARDOUS REMNANTS OF WEAPONS PRODUCTION

Following the shutdown of many of the nuclear weapons production facilities in the late 1980s, much of the special nuclear material in the complex—most of it at the Rocky Flats, Hanford, and Savannah River sites—was not stored in conditions considered safe for the long term. Liquids remained in tanks and bottles where they happened to be located when shutdown orders came, spent nuclear fuel was in transfer basins not designed for long-term storage, and solid materials were packaged in anticipation of near-term recycling—not extended storage. Although DOE had tentative plans to correct some of these conditions, there was a lack of any sense of urgency regarding the need for stabilization and repackaging for safer storage.

In Recommendation 94-1, the Board urged DOE to take action to correct the storage problems in a timely manner, recognizing that the unsafe conditions would become worse with time. Since then, DOE has taken action to mitigate some of the most immediate concerns, but much of the material has yet to be stabilized or packaged for long-term storage or ultimate disposition. This need to stabilize possibly unstable material was seen by the Board as having utmost urgency.

Many of the materials that exist throughout the complex would be more suitably stabilized and stored at a site other than that at which they are currently located, emphasizing the need to integrate activities among the sites. The Board had advocated a stronger integration program as part of Recommendation 94-1, and DOE has had some limited success in this area. For example, with the Board's prompting, integration of some of the stabilization activities has been achieved in the restart of the H-Canyon at SRS, which was approved by the Secretary of Energy in July 1997. The Board had strongly advocated in Recommendation 94-1 the retention of facilities possibly needed in further cleanup and remediation activities, with the Savannah River processing canyons specifically in mind. This advocacy bore fruit in 1997, with DOE's adoption of the two-canyon strategy, made possible by the continued availability of both the F- and H-Canyons. A phased integration strategy, described in DOE's *Savannah River Site Chemical Separation Facilities Multi-Year Plan*, was provided to Congress and the Board in October 1997. It begins to integrate complex-wide material stabilization efforts using SRS's processing canyons.

As a result of continued interaction between the Board's staff and DOE, another initiative, the *Processing Needs Assessment*, proposes to extend this integration activity to include all nuclear materials requiring stabilization. It is intended to utilize DOE assets more efficiently in stabilizing nuclear material.

While processing material for stabilization, packaging, and storage, the fundamental tenets of Integrated Safety Management called for in Recommendation 95-2, as discussed in Section 2, should be satisfied. The hazards of the stabilization, packaging, and storage activities must be identified, and the safety controls needed to prevent or mitigate the hazards must be identified and implemented in the performance of the work. This sort of control remains essential as the DOE

facilities no longer needed for the weapons mission make the transition from operational or standby conditions to deactivation and decommissioning.

4.1 STABILIZATION OF PLUTONIUM (RECOMMENDATION 94-1)

As noted above, one of the main purposes of Recommendation 94-1 was to urge DOE to commit to stabilization of hazardous nuclear materials left over from nuclear weapons production into safe forms for interim storage. The materials included plutonium metal, plutonium oxides, plutonium residues, solutions of plutonium and other actinides, and irradiated fuel and targets. The sites most affected by this recommendation are SRS, the Hanford Site, and RFETS. Other affected sites are INEEL, LANL, ORNL, and the Mound Laboratory. A number of initiatives by DOE have responded to Recommendation 94-1, so that reduction of hazards is now taking place. Progress toward stabilization began to be apparent during 1997.

4.1.1 Plutonium Metal and Oxide

DOE has achieved a number of successes in implementing Recommendation 94-1 during 1997, most notably at SRS and RFETS. Although progress on stabilizing plutonium metals and oxides is continuing, not all sites are aggressive in implementing DOE's commitment to package material to meet DOE's long-term storage standard (DOE-STD-3013). The Board and its staff have continued to monitor preparations at each site for stabilizing and packaging plutonium metal and oxide to the requirements of this standard. The Board has strongly discouraged attempts to weaken the requirements of DOE-STD-3013 and proposals not to package material in the 8-year time frame recommended. For example, the Hanford Site recently proposed not packaging its plutonium metal and oxide to the standard, planning instead to keep such materials in less robust food pack cans until ultimate incorporation in mixed oxide fuel or vitrification at SRS. The Board's staff joined DOE in studies to determine the best viable option. The conclusions of these studies agreed with the Board's position that the safest and best option remained to package material to meet the standard. Hanford is now planning to package its plutonium material as suggested by the Board's staff.

In addition, in response to Recommendation 94-1, DOE had previously repackaged plutonium metal to eliminate direct contact with plastic since radiolytic decomposition of the plastic could generate explosive gases, and is now repackaging plutonium metal that is in proximity to plastic material. During the past year, DOE began using a bagless transfer system at the FB-Line at SRS to package plutonium metal in a welded, inerted inner container in conformance with the long-term storage standard. The Board's staff worked with DOE counterparts at SRS in reviewing the contractor's readiness to conduct this operation safely, improve operating procedures, and help ensure the long-term integrity of the storage container. That program is now proceeding.

As a result of the Board's continued emphasis on the subject, small quantities of plutonium metal that were held at several nonweapons sites were consolidated at the Hanford Site and LANL.

4.1.2 Plutonium Solid Residues

Rocky Flats Environmental Technology Site

The Board has continued to press for stabilization of plutonium solid residues at RFETS, and in 1997, DOE began to achieve success in this regard. With oversight from the Board and its staff, DOE's Rocky Flats Field Office (RFFO) made preparations for limited startup of stabilization of salt residues in Building 707. The staff reviewed the proposed salt stabilization using the tenets of Integrated Safety Management as advocated in Board Recommendation 95-2, including review of the authorization basis, hazards and controls, radiological protection, fire protection, conduct of operations, operator training, and procedures. Although some weaknesses were noted in site-wide programs, such as fire protection, the Board concluded that salt stabilization could safely move forward for salts containing low amounts of americium-241.

Stabilization of other residues (e.g., combustibles; ash; sand; slag and crucible; and graphite fines) may suffer schedule delays. Although results of recent characterization conducted by RFETS indicate that some residues may present less hazard from a chemical instability standpoint than was originally envisioned when the Board issued Recommendation 94-1, the readily dispersible character of some of the residues, such as incinerator ash, may constitute a health and safety issue worthy of closer scrutiny.

Because of the high plutonium content (i.e., > 1 percent by weight) of about 40 percent of the plutonium inventory in residues, safeguards requirements may necessitate one of two approaches: (1) further treatment to separate out the plutonium for long-term storage or (2) immobilization of the residues. The waste from any separation process, as it contains lesser amounts of plutonium, would be shipped to the Waste Isolation Pilot Plant (WIPP). DOE issued a draft Environmental Impact Statement in November 1997; the Record of Decision is scheduled to identify the approach to be used for addressing safeguard requirements. The Board has been closely monitoring this issue in order to understand the impact this decision is likely to have on stabilization of residues and to ensure that momentum in remediation is maintained.

The Board understands that in order to dispel dispersibility concerns, residues could also be stored in more robust containers (e.g., pipe overpacks) until the final Record of Decision is issued. Board Recommendation 94-3 addressed the issue of storage of dispersible residue materials in Building 371 (which is more seismically resistant than other buildings at the site) or in suitably robust containers. In December 1997, the Board suggested that DOE investigate alternate approaches, which included directly packaging residues in robust containers.

Hanford Plutonium Finishing Plant

At the Hanford Plutonium Finishing Plant (PFP), DOE has made only very limited progress in the stabilization of solid residues to meet the objectives of Recommendation 94-1. In December 1996, after completing some cementation of solid residues, DOE halted handling of fissile material at PFP because of repeated instances of poor work control, criticality safety infractions, and lack of management involvement. Throughout 1997, fissile material handling operations at PFP remained curtailed while the contractors attempted to correct deficiencies.

In June 1997, while preparation was being made for restart, a DOE-Richland Operations Office (DOE-RL) readiness assessment identified an unacceptable number of pre-start findings and determined that the PFP was not ready to restart. The Board's review further determined that the attempts to restart PFP following the failed readiness assessment did not directly address PFP's inability to effect permanent corrective action. DOE's efforts did not appear to address the balance between the need to stabilize the plutonium-bearing material and the need to do so safely. A chemical explosion (no nuclear materials were involved) at PFP's Plutonium Reclamation Facility[7] and subsequent DOE and contractor reviews provided further evidence of the need for dramatic improvement in operations.

In a letter dated September 17, 1997, the Board urged DOE to take a series of specific steps prior to resuming the handling of fissile material. These included the clear identification of safety risks at PFP, formal identification of the contractor's recovery actions, formal verification of readiness by DOE, improved actions by line management at DOE-RL to resolve safety issues, and establishment of criteria that need to be met before relaxing the integrating contractor's and DOE-RL's scrutiny of the facility's readiness preparations. DOE's initial efforts to address these issues were inadequate. The Board further clarified its expectations in a letter dated October 22, 1997. Subsequently, the contractors at PFP completed their readiness assessments; however, repeated instances of poor conduct of operations and violations of criticality safety requirements further delayed the resumption of fissile material handling at PFP.

The Board then urged DOE to deploy appropriate and proven expertise from across DOE to expedite improvements in fissile material handling and the resumption of plutonium stabilization at PFP. Subsequently, DOE enlisted the services of outside experts to review the criticality safety program at PFP. By the end of 1997, this review had identified several areas that needed attention.

[7]On May 14, 1997, a chemical explosion occurred at Hanford's PFP. Initiation of the site emergency response process was delayed, response actions were confused, and workers were potentially exposed unnecessarily to noxious airborne vapors. Subsequent review by the local Hanford DOE Operations Office and contractor staff revealed several major and numerous minor deficiencies with PFP and the Hanford Site's safety posture.

The Board continues to monitor safety issues at PFP, with particular attention given to the slow pace of improvement and to a pervasive attitude at PFP that many safety demands are excessive and interfere with expeditious actions.

4.1.3 Liquid Plutonium Residues

Rocky Flats Environmental Technology Site

In Recommendation 94-1, the Board recommended that certain residues, including those in liquid form, should be processed to a form suitable for safe interim storage. Liquid residues are of particular interest since they are easily dispersible and represent a significant criticality issue.

Prior to draining and processing of solutions at RFETS, the Board and its staff reviewed DOE's preparations using the tenets of an Integrated Safety Management System to ensure that the activities could be performed safely. Consistent with the Board's urging, all tanks in Buildings 371, 771, and 886 containing plutonium and uranium solutions have been drained. Workers drained 11 tanks containing plutonium solutions during 1997. Four of these tanks contained high concentrations of plutonium that posed one of the largest nuclear criticality hazards at the site. Approximately 16,000 liters of plutonium or uranium solutions have now been stabilized to a form more suitable for storage. The only liquids remaining are held up in piping, which is to be drained during deactivation of these facilities.

Savannah River Site

In Recommendation 94-1, as well as in a number of other contexts, the Board has noted that conformance to applicable DOE requirements should be confirmed in Operational Readiness Reviews prior to startup of potentially hazardous stabilization of nuclear materials. During preparations for stabilization of solutions containing plutonium-242 (Pu-242) at the HB-Line, several occurrences prompted a Board review, which disclosed deficiencies that could lead to a lack of proper safety controls for operations. These observations were provided to DOE, which took appropriate actions to address the identified deficiencies. The Pu-242 solutions were subsequently stabilized and shipped off site for programmatic use.

4.2 STABILIZATION OF SPENT NUCLEAR FUEL IN RESPONSE TO RECOMMENDATION 94-1

4.2.1 National Spent Nuclear Fuel Program

DOE's National Spent Nuclear Fuel Program coordinates activities at the various DOE sites involved in putting spent fuel into safe interim storage. The goal of this national program is to ensure that the storage canisters can ultimately be sent to a national repository without

repackaging. During 1997, the Board's staff worked with responsible DOE staff to emphasize coordination of spent fuel storage activities at the Hanford Site, SRS, and INEEL.

4.2.2 Hanford Spent Nuclear Fuel Program

Deteriorating spent nuclear fuel in the K-Basins presents a serious threat to the health and safety of the public and workers at the Hanford Site. In its original response to Board Recommendation 94-1, DOE committed to remove the spent fuel from the basins and to place it in interim dry storage at the site.[8] DOE committed to start removal of the spent fuel by the end of 1997 and to complete removal by December 1999.

In August 1997, DOE announced that the start of fuel removal would be delayed at least until July 1999. As a result, the Board initiated an in-depth technical and project review. This review identified numerous deficiencies in the conduct of the project that would cause additional delays in the safe, expeditious stabilization and storage of the highly hazardous, deteriorating spent nuclear fuel. The results of this review were documented in DNFSB/TECH-17, *Review of the Hanford Spent Nuclear Fuel Project*, which was transmitted by a November 17, 1997, letter from the Board to the Assistant Secretary for Environmental Management. Details of the staff review are included in Section 2.5.1 of this report. DOE expects to submit a detailed response to the Board by March 1998. This report, and subsequent changes to the 94-1 implementation plan, are scheduled to be reviewed by the Board and its staff to ensure the urgent reduction of the risks associated with continued storage of the spent fuel in the K-Basins.

4.2.3 SRS Spent Nuclear Fuel Program

In DNFSB/TECH-7, *Stabilization of Deteriorating Mark 16 and Mark 22 Aluminum-Alloy Spent Nuclear Fuel at the Savannah River Site*, the Board established the technical case for requiring that deteriorating irradiated spent nuclear fuel stored in the basins at SRS be stabilized by chemical separation. During this past year, the last of the Mark 31 target elements was stabilized in the F-Canyon/FB-Line. After reviews by the Board and its staff to ascertain that analysis of hazards and identification and implementation of necessary safety controls and facility equipment and personnel readiness were properly established prior to restart, SRS began dissolution of the Mark 16 and Mark 22 spent nuclear fuel in the H-Canyon. These reviews included observation of Operational Readiness Reviews (ORRs) by the Board's staff and a briefing to the Board by DOE regarding results of the Operational Readiness Reviews and resolution of safety issues. The Board's specific attention to having DOE demonstrate the most technically justified process for stabilization has contributed to definitive progress in resolving the problem of deteriorating defense-related spent nuclear fuel.

A large inventory of non-defense-related, aluminum-alloy spent fuel is also in wet storage at SRS, and the quantity of this inventory will assuredly continue to increase as additional fuel is

[8]Design and construction aspects of the Spent Nuclear Fuel Project are discussed in Section 2.5.2.

received from off site. This aluminum-based spent fuel cannot be left in wet storage indefinitely, and, like commercial spent fuel, it also requires special treatment before disposal. DOE is currently evaluating alternatives for removing this spent fuel from wet storage. The Board has reviewed the developments during 1997, and intends to continue to monitor DOE's progress in this area, particularly where it affects defense nuclear facilities.

4.2.4 INEEL Spent Nuclear Fuel Program

At INEEL, DOE has continued aggressively to stabilize spent fuel and has met all Recommendation 94-1 milestones to date. Because of concerns with storage conditions for spent fuel under water at the Chemical Processing Plant-603 (CPP-603) Fuel Storage Facility, DOE committed to removing this fuel by December 2000. Most spent fuel that does not require overpacking has already been removed from CPP-603. Spent fuel that requires overpacking is to be processed in the dry storage overpacking station, which began operation in mid-1997—more than a year ahead of the Recommendation 94-1 milestone date. The Board and its staff continue to review these activities to ensure they are performed safely and promptly.

Some of the spent fuel from CPP-603 is scheduled to be placed in dry storage at the Irradiated Fuel Storage Facility. However, structural analysis in 1996 showed that one wall of the building was seismically inadequate. The Board's staff reviewed the corrective actions, the effects of proposed retrofits, and additional analyses performed to verify the adequacy of other portions of the facility. Construction activities to correct identified problems, which were also monitored by the Board, were completed successfully in December 1997.

4.3 STABILIZATION OF ENRICHED URANIUM (RECOMMENDATION 94-1)

4.3.1 Molten Salt Reactor Experiment Stabilization Project

DOE's commitments in the implementation plan for Board Recommendation 94-1 included stabilization and removal of residual nuclear materials from the Molten Salt Reactor Experiment (MSRE) at the Oak Ridge National Laboratory. MSRE ceased operation in 1969. These residual nuclear materials included reactive gases and uranium fluoride salts (the uranium includes the isotope U-233). The reactive gases (primarily fluorine and uranium fluoride) were removed from the head spaces of drain tanks and from off-gas system (OGS) piping by chemical trapping, which reduces the gas pressure and allows other risk reduction activities to commence.

The process for removal of reactive gas was modified because of the inability of the original gas removal system to sublimate the nonvolatile deposits plugging the piping in several areas and the need to ensure timely implementation of the project. The contingency plan developed by the contractor to bypass the blockages and dissolve them by introducing chlorine trifluoride (ClF_3) to the OGS is expected to increase the uranium removal rate significantly. This

alternate approach was evaluated by the Board to confirm that adequate attention had been given to ensuring the health and safety of workers and the public.

Uranium deposit removal from the auxiliary charcoal bed (ACB) filter, fuel and flush salt removal from the drain tanks, and uranium stabilization/conversion to oxides are also in the scope of this project. The Board reviewed the use of ammonia to passivate the fluorinated charcoal in the ACB (the first phase of uranium deposit removal), and found the chemical analysis and methodology of operations sound.

DOE and contractor personnel reviewed the technical changes to the approach for safely stabilizing these materials, and satisfactorily addressed the Board's questions during a July 1997 briefing. This was followed by an October 29, 1997, letter from the Secretary of Energy to the Board, proposing changes to DOE's implementation plan commitments for the MSRE materials. The Board's December 8, 1997, letter to the Secretary of Energy included acceptance of the changes to the plans for MSRE stabilization and the resultant schedule slippage, and noted the apparently sound approach being taken to address criticality and issues associated with the hazards.

4.3.2 Uranium Deposit Removal Project at East Tennessee Technology Park (ETTP)

The Board's staff has continued to monitor the commitment in DOE's implementation plan for Recommendation 94-1 to remove all uranium deposits at ETTP that present a significant criticality issue. The Board's staff requested a reevaluation of the removal program when it became apparent that significant delays would affect achieving removal milestones. Initially, the safety evaluation identified deposits at risk based solely on U-235 mass and enrichment. Subsequently, more comprehensive criticality safety measures were developed for each deposit, and risk categories were established that reduced the number of deposits that required risk reduction activities within the next year.

All of the highest-risk deposits were removed during 1997; lower-risk deposits are on schedule to be removed in early 1998; remaining deposits are in a safe configuration, managed under a surveillance and maintenance program while awaiting decommissioning of the facility.

DOE and contractor personnel satisfactorily addressed the Board's questions during the same July 1997 briefing to the Board noted previously for the MSRE stabilization project. These changes were also addressed in the October and December exchange of correspondence noted in Section 4.3.1 above.

4.4 STABILIZATION OF URANIUM-233 IN RESPONSE TO RECOMMENDATION 97-1

The main purpose of Recommendation 97-1, *Uranium-233 Storage Safety at Department of Energy Facilities*, was to urge DOE to provide safe storage for its U-233 material. The Board recommended that DOE develop a standard addressing the storage requirement and assess the adequacy of the current storage of this material be assessed.

The Board and its staff have been involved during the past year with development of a new standard, which should provide criteria for safe storage of U-233. This standard is expected to be issued by DOE in 1998.

Building 3019 at Oak Ridge National Laboratory functions as the national repository for U-233. To meet commitments of Recommendation 97-1, DOE proposed using this facility to provide U-233 handling and processing capabilities. The transition of Building 3019 from a passive, storage-only facility to an expanded operational mode requires substantial upgrades to the authorization basis, safety documentation and procedures, equipment, and personnel. The Board and its staff are working with DOE to ensure that use of the building meets the near-term objectives of Recommendation 97-1.

In Recommendation 97-1 and its supporting report, DNFSB/TECH-13, *Uranium-233 Storage Safety at Department of Energy Facilities*, the Board raised several safety issues associated with the use of Building 3019. In response, DOE made a commitment in its 97-1 implementation plan to address these safety issues in a timely fashion, including a safety assessment of the suitability of the building for its intended purpose.

During the facility assessment conducted in accordance with obligations under Recommendation 97-1, cognizant personnel at Oak Ridge found that several activities would improve near-term U-233 storage safety in Building 3019. Improvements were proposed in risk-based ranking of inventory, initial characterization of well vaults, analysis of hazards of well vaults, analysis of hazards from natural phenomena, and acquisition of equipment for remote handling. A plan has been developed to address these improvements. The Board and its staff continue to monitor risk reduction through on-site reviews.

4.5 IMPROVED STORAGE OF HAZARDOUS MATERIALS

4.5.1 Building 371 at the Rocky Flats Environmental Technology Site

The fundamental purpose of Recommendation 94-3 was to ensure adequate safe storage of special nuclear material at RFETS. This involved determining that Building 371, including structures, systems, and components (SSCs), could be made capable of meeting the storage mission through upgrading of the facility and improvement of the authorization basis on which

safe operation is based. As a result of the Board's Recommendation, DOE committed to complete the modifications needed to upgrade the facility and to upgrade the authorization basis for operations in the facility.[9]

Initial reviews of the development of the authorization basis documents, the Basis for Interim Operation (BIO), and the status of implementation of the upgrades for Building 371, which were commitments contained in the Integrated Program Plan (IPP), indicated a need for more effective project management by the integrating contractor, Kaiser-Hill (K-H), and the Rocky Flats Field Office (RFFO). The K-H organizational structure had become partitioned without overall integration of the multiple facets of the IPP; consequently, accomplishment of actions committed to in the IPP was much delayed. Furthermore, the BIO was being prepared with less technical rigor than had been committed to in the IPP, and the proposed controls upon which the implementation of the authorization basis would be based were not developed in a conservative manner.

As a result of the Board's review in February 1997 and subsequent reviews by the Board's staff, K-H and RFFO took action to correct the situation. K-H reorganized the project by placing all relevant operations under the control of a strong, technically competent manager as the single point of contact and changed its organizational structure to meet the intent of Recommendation 94-3. DOE assigned a full-time individual to oversee progress on the project. The project was reorganized to integrate all technical activities.

At the end of 1997, the first set of upgrades, the Priority Upgrades, was close to completion, as originally provided in the IPP. Furthermore, pending resolution of Board concerns regarding several accident scenarios, the BIO and resulting controls appeared to be nearing completion in a satisfactory manner.

4.5.2 Actinide Packaging and Storage Facility (APSF) at the Savannah River Site

The APSF is intended to provide safe, secure, cost effective storage of special nuclear material (SNM) for up to 50 years and to meet commitments under the implementation plan for Recommendation 94-1 for SRS. Currently, the facility is sized to store material from both RFETS and SRS. Construction of the APSF is scheduled to begin in mid-1998; the facility is scheduled for start-up late in 2001. The Board and its staff are reviewing DOE's physical design for APSF and its operational considerations, which assume the availability of APSF to receive and process material for storage.[10]

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[9]Design and construction aspects of Building 371 upgrades are discussed in Section 2.5.2.

[10]Ongoing design reviews of the APSF are discussed in Section 2.5.2

4.5.3 UF_6 Storage in Response to Recommendation 95-1

Approximately 50,000 cylinders containing more than 500,000 metric tons of depleted uranium hexafluoride (UF_6) from the production of enriched uranium for both defense and civilian purposes are stored outdoors at gaseous diffusion plants in Oak Ridge, Tennessee; Portsmouth, Ohio; and Paducah, Kentucky. In early 1995, the Board found that the corrosion-resistant coatings of the cylinders had not been maintained and that many cylinders were handled and stored under conditions that could lead to increased breaching of the cylinders. To protect against further cylinder breaches and the resulting potential for dispersion to the environment of large amounts of UF_6, the Board issued Recommendation 95-1, *Improved Safety of Cylinders Containing Depleted Uranium*, in May 1995, urging DOE to address the problem promptly. Since then, significant actions have been taken by DOE to slow the degradation of cylinders from external corrosion.

During 1997, the Board's review of Final Safety Analysis Reports (FSARs) developed in response to Recommendation 95-1 found that the FSARs did not identify adequate controls to prevent or mitigate a potential fire during handling of cylinders. A fire starting from ignition of fuel in a vehicle used for on-site transport of cylinders could cause a cylinder containing UF_6 to rupture and release uranium and hydrogen fluoride, with serious health consequences to nearby workers and to other personnel beyond the site boundary. In response to a June 1997 Board letter on this issue, DOE is installing fire-suppression equipment on the cylinder handler vehicles and limiting allowable fuel quantities. These measures are expected to be effective in protecting the UF_6 cylinders if such an event were to occur.

While significant action has been taken, other steps remain, including establishing cylinder coating programs to recoat cylinders with the most severe corrosion in storage at all three sites. Actions to establish such coating programs are underway. The Board intends to continue to monitor DOE's progress in implementation of Recommendation 95-1.

4.5.4 Storage of Low-Assay Plutonium-238 at the Savannah River Site

A review of Pu-238 operations in the HB-Line at SRS revealed that the site's Management and Operating contractor intended to move significant quantities of Pu-238-bearing material from vault storage at the HB-Line to the 235-F building, to reduce overhead costs at the HB-Line. However, Building 235-F is ill-suited for storage of Pu-238, because it has no capability to handle or repackage containers that develop problems. After this issue was investigated by the Board and its staff, DOE did not pursue this course of action further.

4.5.5 Storage of Cesium-137 at the Waste Encapsulation Storage Facility at the Hanford Site

The current mission of the WESF is to store safely approximately 1300 cesium chloride capsules and 600 strontium fluoride capsules in water-filled storage pools until the year 2017.

This highly radioactive material (146 million curies) represents approximately one-third of the total radionuclide inventory at the Hanford Site. The contractor has developed a Capsules Management Plan, which proposes a permanent disposition for these capsules. The plan is under review by the Board and its staff.

The Board's staff had previously identified several potential safety issues regarding long-term storage of the capsules in a facility considered likely to be vulnerable to potential earthquakes. The consequences of postulated accidents involving seismic vulnerabilities are documented in the BIO, scheduled for review by the Board's staff in early 1998.

Sixteen damaged or out-of-specification capsules of cesium chloride, each containing about 50,000 curies of cesium-137, were planned for overpacking in an earlier container design (Type S). Partly as a result of questions raised by the Board's staff, the contractor designed an improved container (Type W), which provides better material confinement.

4.5.6 Hazardous Chemical Storage Implications

As a result of a chemical explosion at the Plutonium Finishing Plant complex at the Hanford Site in May 1997, the Secretary of Energy issued directives on chemical vulnerabilities to all sites in the defense nuclear complex. While chemical releases are not specifically under the Board's cognizance, the potential for release of radioactive materials as a result of energetic chemical reactions is of concern to the Board.

The Board plans to monitor the responses of all DOE defense nuclear sites to the Secretary of Energy's directives on chemical vulnerability. The need for strong action has become even more apparent since other chemical explosions and container overpressurizations from chemical reactions have occurred elsewhere in the defense nuclear complex, e.g., the Fernald nuclear waste container explosion and several nuclear waste drum overpressurizations at LLNL and LANL.

The Board has formed a chemical safety team to review all major DOE sites with large holdings of process chemicals, hazardous waste, and reagent chemicals. A review revealed that within the past year at RFETS, progress has been made in upgrading the site's chemical inventory and in eliminating unnecessary hazardous materials. The Board's team is scheduled to continue to monitor progress at RFETS, and is preparing for reviews at other sites in the coming year.

4.6 WASTE MANAGEMENT

Nuclear weapons production during more than 50 years has yielded in excess of 60 million gallons of highly radioactive waste stored in underground tanks at the Hanford Site, SRS, and INEEL. DOE is committed to retrieving and immobilizing these wastes prior to their disposal in a geological repository. Safe storage of these high-level wastes requires vigilance to prevent

accidental release from aging storage tanks. The Board's activities to ensure such protection are presented below.

4.6.1 Activities at the Savannah River Site

In-Tank Precipitation Facility (ITP)

ITP is a pretreatment facility designed to concentrate and remove most of the radioactive fission products from high-level liquid waste residing in large underground tanks at SRS.[11] The separated fission products are to be vitrified at the Defense Waste Processing Facility, with the decontaminated liquids processed for disposal at the Saltstone Production Facility.

In the ITP process, an organic chemical, sodium tetraphenylborate, is added to liquid waste that has been transferred to a million-gallon processing tank, to precipitate radioactive cesium. During the process, chemical and radiolytic decomposition of the tetraphenylborate occurs, generating substantial quantities of benzene, a flammable and carcinogenic gas. Test results have shown that both the excess tetraphenylborate in solution and the precipitated solids are vulnerable to decomposition caused by catalytic attack by waste constituents such as copper and palladium. If the accumulated precipitates were to decompose rapidly and the benzene were to be evolved from the slurry, the resulting benzene release could be very large. Such an event would pose a major flammability hazard. As discussed in the Board's Seventh Annual Report to Congress, Recommendation 96-1, *In-Tank Precipitation System, Savannah River Site*, was issued in August 1996, urging DOE to ensure that the chemical reactions and associated hazards are adequately understood and controlled before ITP commences operations.

During the past year, the Board continued monitoring DOE's experiments to characterize ITP's chemical process to ensure that adequate understanding is developed to support safe operations. The Board reviewed DOE's test plans and the results of the testing to ensure that the scope of the testing was sufficient to produce the required information and that the test results were being put to proper use.

The ITP chemistry program has determined that the tank wastes contain catalysts for benzene generation, and confirmed the Board's concern that precipitated tetraphenylborate solids can be a significant source of benzene. Several benzene mechanisms have also been characterized, and the very large benzene retention capability of the ITP slurry has been demonstrated. The laboratory results show that exceptionally high benzene generation and release rates are possible,

[11] In January 1998, DOE informed the Board that preparations to start high-level waste pretreatment operations at the ITP have been suspended because of concerns over safety and process effectiveness identified by the chemical testing program developed in response to the Board's Recommendation 96-1. This action has highly significant implications for the vitrification of high-level radioactive wastes in tanks at SRS, the full impact of which is yet to be determined. DOE intends to investigate alternatives to ITP during the coming year. The Board plans to monitor this investigation closely. The Board also plans to evaluate the interim waste management program that will be required to accommodate the delays in waste treatment at SRS.

and operation of ITP in its current configuration cannot be supported unless positive controls can be developed.

The Board also has continued to evaluate preventive and mitigative safety systems being developed for ITP that are meant to protect facility workers and the public from undue risk. In particular, the Board has focused on the adequacy of the nitrogen purge systems intended to prevent deflagrations in the process tanks. The Board formally commented to DOE that undue reliance on administrative controls, instead of engineered safety systems, should be avoided, particularly for a facility with such a prolonged mission.

In a December 1997 letter, DOE's Savannah River Operations Office (DOE-SR) informed the Board that the strategy for resolving safety issues associated with ITP is being reevaluated. DOE-SR stated that the current level of understanding of ITP chemistry does not support the original plan to close Recommendation 96-1 by the end of 1997, and committed to provide, by March 1998, an updated action plan for closure of Recommendation 96-1.

The Board intends to ensure that the DOE-SR action plan defines a clear path forward for resolving the technical questions that remain. It is important, too, that DOE consider what will be done if these issues cannot be resolved satisfactorily. The function to be provided by ITP needs to be available within a few years to support high-level waste vitrification activities at SRS. If the ITP process cannot be implemented, DOE will need to develop an alternative process in a timely manner.

This activity remains one of the Board’s highest priorities. The combination of high-level waste and benzene generation at ITP is a unique hazard that needs to be carefully analyzed and controlled, and the potential problems still have not been fully defined or resolved.

High-Level Waste Tank Farms

DOE is in the process of developing an upgraded Safety Analysis Report and a set of Technical Safety Requirements for the high-level waste tank farms at SRS. A need for improvements related to conduct of operations in the tank farms has been disclosed in the past year, including deficiencies in procedures, failure to follow procedures, and lack of configuration management. The Board has held continuing discussions with DOE regarding measures to remedy these problems.

During 1997, the Board's reviews identified several additional issues associated with the safety management program for the SRS high-level waste tank farms. The process used for tracking and resolving open safety issues at the tank farms was found to be deficient. Potentially serious safety issues, such as the potential for accumulation of flammable gases in tank waste sludges, were being studied for extended periods without application of the formal Unreviewed Safety Question process or implementation of formal interim operational controls in order to

ensure that the tanks were in a safe condition. DOE subsequently found more examples of this lack of rigor and revised its procedural process to eliminate the problem.

A review by the Board's staff of the new authorization basis (still under development) revealed a flawed probabilistic analysis used to justify removing a requirement to provide active ventilation of the tanks. Active ventilation had been deemed necessary to prevent flammable gases from accumulating in the tank's vapor space. The new authorization basis stated that periodic vapor sampling would ensure that the likelihood of deflagration in a tank was acceptably small. Because of the inadequacies in conduct of operations in the tank farms, as well as the flaws in the analysis of the new controls, the Board concluded that elimination of active ventilation in favor of administrative controls was imprudent. DOE subsequently reviewed this matter, and concluded that active tank ventilation should continue.

Finally, implementation of a new authorization basis at an existing facility, such as the SRS tank farms, requires verification that safety systems called for by the new authorization basis are present and operable. Reviews by the Board and its staff disclosed plans to implement the new authorization basis and the new controls formally before the backfit of requisite equipment had been completed. After this problem was identified, DOE evaluated the differences between the old and new authorization bases, prioritized the backfit analyses, and presented a defensible path forward for implementing the new controls.

High-Level Waste Evaporators

The two operating evaporators at SRS play an integral role in managing the total volume of waste in the high-level waste system. Early in 1997, it was determined that sludge could become entrained in the liquid feed to the evaporators, resulting in a dramatic increase in potential consequences of certain postulated evaporator accidents. At that time, DOE decided to suspend operation of the evaporators.

Corrective actions involved a number of facility modifications, including modification of the feed system to reduce sludge entrainment, installation of a redundant isolation valve on the high-pressure steam system for one evaporator (a redundant steam isolation valve should be installed on the second evaporator in early 1998), and establishment of a radiological inventory limit on the feed to the other evaporator. The evaporators were then restarted. However, in response to issues subsequently raised by the Board regarding the consequences of certain accidents, DOE refined the safety analyses to better define the risk of operating the evaporators and established additional administrative controls to improve the safety of evaporator operation. These included reducing the amount of time allowed to isolate high-pressure steam in the event of a steam tube rupture, and requiring operator action to isolate ventilation of the building should an accident take place so as to reduce the consequences.

4.6.2 Tank Waste Remediation System Activities at the Hanford Site

As described in several previous Board Annual Reports, one of the major systems engineering initiatives of DOE in cleanup has been that of addressing the Hanford Site's large inventory of radioactive waste. The Tank Waste Remediation System (TWRS) is expected to retrieve, process, and immobilize more than 50 million gallons of high-level radioactive waste currently stored in 177 underground storage tanks at the Hanford Site. The Board's actions relevant to TWRS have followed several lines.

Recommendation 92-4, Systems Engineering

In 1992, the Board had noted deficiencies in the technical justification and planning for the Hanford TWRS Multi-function Waste Tank Facility (MWTF). In its Recommendation 92-4, the Board had recommended, in part, that DOE adopt a systems engineering approach that would ensure that health and safety requirements of the project were addressed in each phase of the project's life cycle. DOE's implementation plan committed to a systems engineering approach for the entire TWRS.

Since 1992, several changes in the scope and approach to the TWRS necessitated changes in DOE's implementation plan for Recommendation 92-4. Systems analysis indicated that the MWTF was not needed. DOE canceled or reduced the scope of other projects as a result of refined analyses, as well as budget cuts. In a major change to the TWRS, DOE has more recently adopted a "privatization" concept, according to which waste processing is to be accomplished by private contractors using their own technologies, their own facilities, and their own capital. The contractors are to demonstrate their technology before additional contracts are let for full-scale processing.

During 1997, DOE revised its 92-4 implementation plan to reflect the many changes that had occurred at TWRS in the intervening years. The Board's staff interacted with its DOE counterparts to ensure that DOE would manage the safety of the TWRS as a total system regardless of the different contracting mechanisms. These expectations were also communicated by individual Board members to DOE senior management, as well as through numerous site visits.

Partly in response to the Board's concerns, DOE and its contractors began development and use of the TWRS Program Logic, which provides the overall structure of the TWRS program, including primary prerequisites, interfaces, and chronology. It identifies those portions of the TWRS that are to be privatized and shows those activities presently performed by the existing contracting team that interface with the proposed privatized projects. The logic is fundamental to overall systems engineering of the program up through treatment of the waste.

DOE has committed to systems integration of the proposed privatized portions of the TWRS with the overall program. As committed to in the revised 92-4 implementation plan, the physical, administrative, and safety interfaces between the private contractors and the operating

contractor are scheduled to be developed and documented, to ensure that DOE manages the TWRS as an integrated system.

Recommendation 93-5, Tank Waste Characterization

The Board has long considered that adequate characterization of the wastes in the Hanford tanks is the critical first step to ensuring safe storage and eventual successful remediation of the wastes. To that end, in Recommendation 93-5, the Board had urged DOE to expedite the characterization of the wastes with the goals of establishing with more certainty the safety measures for safe storage and obtaining information needed for the design of processing facilities. By the end of 1997, largely at the urging of the Board, DOE had made substantial progress toward these goals as follows:

- To date, DOE has sampled 131 of the 177 tanks.

- As reported in the Board's Seventh Annual Report, DOE resolved the safety issue associated with the potential for explosion in waste tanks containing ferrocyanides. Characterization of tank wastes determined that the ferrocyanides had degraded to relatively benign compounds.

- In 1997, DOE made progress toward developing a similar understanding about potentially flammable organic compounds, but additional sampling and characterization are required to validate the technical assumptions of the rationale. Further analysis is also required to validate historical information relied upon to justify applying the rationale to tanks that are not sampled.

- Through use of a void fraction instrument and a gas-tight sampler, as well as by theoretical analysis, DOE significantly improved its understanding of the flammable gas issue.

- After thorough review by the Board and its staff, DOE deployed its Rotary Mode Core Sampling Truck in 1997, allowing the sampling of hard wastes.

Despite this progress, several issues are likely to occupy the Board and its staff during 1998. Although the flammable gas issue is better understood, some important uncertainties remain. Hanford has begun soliciting the opinions of experts in the field of nuclear safety and chemistry on several technical parameters associated with flammable gas generation, retention, release, and ignition. DOE hopes to use this information to show that the risk of flammable gas burns is negligible or, alternatively, to identify additional controls that can make it so. During 1998, the Board and its staff plan to review the results of this effort to ensure that closure of the flammable gas issue is technically justified.

Additionally, DOE hopes to show that the consequences of a burn of liquid organic solvent pools that may exist in some tanks would be sufficiently minor when combined with the probability of such an event occurring to make the risk of this accident negligible. The Board continues to review this issue to ensure that appropriate controls are implemented to prevent such a burn.

Integrated Safety Management at the Tank Farms

Prior to 1997, the safety basis of the tank farms consisted of a fragmented collection of more than 300 individual safety analyses. As documented in several Board letters and staff trip reports, the Board had been dissatisfied with the technical adequacy of safety analyses for the tank farms and the rigor with which they were implemented. Board Recommendation 95-2 and technical reports DNFSB/TECH-5, -6, and -16 further communicated to DOE and its contractors the Board's expectations relative to safety analysis documentation in the context of an overall Integrated Safety Management program. After 18 months of effort, including several reviews by the Board's staff, and at the direct urging of the Board members, DOE and its contractors developed a consolidated BIO as the fundamental safety basis document for the tank farms. Significantly, DOE implemented the BIO in September 1997 without a major disruption in operations. DOE is currently engaged in identifying those additional elements of an overall Integrated Safety Management program that need to be developed and implemented. This activity is the basis for identifying and ensuring the availability of controls needed to ensure continued safety at the tank farms. Review of the activities is likely to occupy the Board and its staff in 1998.

4.6.3 Idaho National Engineering and Environmental Laboratory

To reduce the risks associated with long-term storage of high-level waste in tanks at the Chemical Processing Plant, INEEL calcines the waste in the New Waste Calcining Facility and stores this solidified product in on-site bins. Calcining operations were shut down in November 1993 for maintenance, modifications, and construction of a high-level waste evaporator.

In Recommendation 94-1, the Board recommended that preparations for restart of operations take into account the need for Operational Readiness Reviews. DOE's ORRs were conducted for the evaporator and calciner in 1996 and again in 1997. For both facilities, the Board noted that a second review was required because DOE line management allowed the contractor to declare readiness before a safe basis to proceed with operations had actually been established. These problems led the Board to request formally that DOE evaluate its process for verifying readiness. In response, DOE's Idaho Operations Office has improved its process for verifying readiness and intends to use this improved process prior to future start-ups of operations at INEEL.

After satisfactory ORRs, which the Board's staff observed and whose findings the staff reviewed, the evaporator and calciner began operations in June 1996 and June 1997, respectively.

INEEL has calcined more than 200,000 gallons of high-level waste since the calciner operation was restarted.

4.6.4 Waste Isolation Pilot Plant (WIPP)

Since late 1994, the Board's attention to WIPP has been greatly reduced because of operational delays due to the various administrative, procedural, and legal obstacles that precluded the receipt of transuranic (TRU) waste at WIPP. Consequently, a very low level of effort was expended on WIPP for several years.

In late 1997, however, in light of the scheduled May 1998 start of waste disposal operations, the Board stepped up its activities to track WIPP developments and to reexamine WIPP public health and safety issues. The Board reviewed the documents for the safety authorization basis for conformance with the principles of the Board's Recommendation 95-2, and reviewed waste characterization and certification audits conducted by DOE's Carlsbad Area Office for those storage/generator sites expected to make the initial shipments of TRU waste to WIPP.

The Board's staff plans more detailed actions in early 1998, including oversight of DOE's plans for its ORR, scheduled for March 1998.

4.7 DEACTIVATION AND DECOMMISSIONING

As DOE's mission at many facilities has changed from production of nuclear weapons to stewardship of the weapon stockpile and cleanup of contamination remaining from earlier activities, the Board has paid increased attention to the cleanup of facilities no longer needed for the weapons mission. As noted earlier, the Atomic Energy Act requires the Board to review and evaluate the content and implementation of standards (including applicable DOE orders, regulations, and requirements) relating to the design, construction, operation, and decommissioning of each DOE defense nuclear facility. Decommissioning commences in earnest when DOE determines that facilities are no longer needed to support the weapons program; the facilities are then scheduled for deactivation and eventual dismantlement or reuse.

With respect to deactivation and decommissioning, the Board has placed its emphasis on the following:

- The need to stabilize special nuclear materials that are unstable residues of the weapons production program so they can be safely stored until final disposition (see Section 2.5).

- The initial cleanout of relatively stable, yet hazardous, remnants of mixed and nuclear materials in process lines, tanks, ducts, and other process equipment to allow facilities so contaminated to be deactivated to a safe standby state.

- The location and characterization of known fixed and mobile radioactive residuals after initial deactivation, to facilitate the work planning/safety planning required of DOE at many defense nuclear facilities by EPA and the states before final demolition and cleanup commences when CERCLA and RCRA apply.

In keeping with its legal obligations for assessing hazards to the health and safety of workers and the public, and in cooperation with EPA and State authorities, the Board has focused its attention with regard to deactivation and decommissioning primarily on the RFETS, the Hanford Site, and SRS—three locations that DOE has selected for early cleanup, as discussed below. The number of cleanup projects selected by the Board for priority attention, using considerations set forth above, are few relative to DOE's total environmental restoration program.

4.7.1 Deactivation and Decommissioning Activities at the Rocky Flats Environmental Technology Site

Building 771

The Board has identified Building 771 (Plutonium Recovery Facility) at RFETS as one of the facilities in the defense nuclear complex with the highest priority for decommissioning. It is intended to be the first major plutonium facility to undergo an integrated closure process which takes a building with a very substantial quantity of residual radioactive materials through a major hazard reduction mode to eventual demolition in a seamless, continuous fashion. The proposed six-phase approach includes, sequentially (1) major hazard reduction, (2) equipment dismantlement, (3) building decontamination, (4) utility system shutdown, (5) building demolition, and (6) site remediation.

Building 771 contains more than 50 kg of plutonium held up in glove boxes, ducts, equipment, plenums, furnaces, 268 tanks, 50,000 ft of piping, 188 glove boxes, and 43 contaminated rooms or areas. The Board's staff completed reviews to ensure that certain predecommissioning activities, such as removal of actinide solutions, were successfully completed in accordance with the requirements of Recommendation 94-1. Decommissioning activities scheduled by DOE for 1998 include planning and preparation of documentation for deactivation and decommissioning, scanning of special nuclear material, and removal of residue drums and hold-up material from piping and tanks. DOE expects planning for closure to be completed early in 1998. Requisite documents for work planning/safety planning under CERCLA, such as the Decommissioning Operations Plan, are expected to be submitted by mid-year. The Board's staff, in cooperation with EPA and state authorities, is expected to take an active role through on-site reviews and technical evaluations of planned nuclear safety measures.

Building 779

Nuclear decommissioning of Building 779 (Plutonium Process Development Building) is a pilot project. DOE intends that the knowledge and experience gained during closure of this moderate-risk plutonium facility will be used in future disposition of high-risk facilities at RFETS. During the past year, the Board's staff oversaw removal of a hydride prefilter that was loaded with more than 2 kg of plutonium, and took numerous tours of the work place to ensure that remediation of gloveboxes proceeded safely. Activities such as trash removal, disposition of excess equipment, and housekeeping are expected to continue in Building 779 until formal turnover to the next stage of decommissioning is undertaken in early 1998. The Board's staff has reviewed the Building 779 Decommissioning Operations Plan, which is awaiting approval, and has provided informal comments for its improvement to a team consisting of representatives from DOE, the contractor and the regulators (EPA and the State of Colorado). The Board's staff plans to continue its review of Building 779 decommissioning until the nuclear hazards are substantially reduced.

Building 886

Numerous decommissioning activities in Building 886 (Site Critical Mass Laboratory) were accomplished during 1997. For example, 2700 liters of highly enriched uranyl nitrate was removed from tanks in Building 886, thus permitting decommissioning operations, such as removal of holdup solutions, removal of Raschig rings, reduction of safeguards, capping and venting of tanks, removal of process piping, and sealing of glovebox ports. The Board's staff conducted reviews to ensure that these activities were planned and executed with appropriate consideration given to safety. Because of funding limitations, decommissioning activities in 1998 are expected to be restricted to planning, characterization, and removal of trash and furniture.

4.7.2 Deactivation and Decommissioning Activities at the Hanford Site

Plutonium Concentration Facility

The Plutonium Concentration Facility (233-S) was built in 1955 to expand plutonium production by further concentrating the plutonium nitrate solution that was the product of the operation of the REDOX Plant, a nuclear solvent extraction plant. The 233-S facility operated until July 1967, at which time the building was added to DOE's Surplus Facility Management Program as a retired facility. An estimated 1.5 kg of plutonium-239 remains in the process portion of the facility. DOE's planned removal action includes dismantlement and disposal of highly contaminated process systems and decontamination and/or stabilization of the facility, followed by its demolition and disposal.

In November 1997, the Board's staff reviewed the safety documentation for decommissioning of 233-S. The review focused on incorporation of the principles of Integrated Safety Management outlined in DNFSB/TECH-16 for the removal of highly contaminated process

equipment and the processes for planning and implementing work related to these activities. A combination of administrative and engineered controls, as well as personnel protective equipment, is expected to be used during the course of removing highly contaminated process equipment. Bechtel Hanford Incorporated (BHI) has placed heavy reliance on personnel qualification and competence as its primary means for ensuring safe conduct of these operations. Thus, the level of personnel competence and experience noted during the November 1997 review must be maintained by BHI throughout the dangerous removal of process equipment. BHI and DOE plan to conduct an Operational Readiness Review before dismantlement of process equipment, and additional reviews by the Board's staff are planned.

Removal of the plutonium is scheduled to be performed as a pilot project, integrating DOE's nuclear safety analysis and worker safety requirements with the provisions of the DOE/EPA Joint Policy for Decommissioning Under CERCLA. Estimated project completion is in FY 2001.

105-N Basin

The N-Reactor was a dual-purpose reactor producing plutonium for military purposes and steam for generation of electricity. It operated from 1963 through 1987. The 105-N Basin at the N-Reactor received irradiated fuel assemblies discharged from the N-Reactor during its operating lifetime. In 1989, the reactor was completely defueled, and all remaining spent fuel was removed from the basin. In 1995, BHI began removing debris from the 105-N Basin, and that activity continues. Debris remaining in the basin includes basin sediment, as well as highly radioactive material (greater than 1 rad per hour on contact) and low-level radioactive material.

The Board's staff observed basin cleanup in 1997, including hardware removal, relocation of sediment, and treatment of basin water to improve water clarity. The staff issued a combined trip report following reviews in February and April 1997 that identified deficiencies in conduct of operations, radiological controls, and work planning. BHI experienced other operational and engineering difficulties during the year that adversely affected the project's schedule. BHI originally planned to complete the cleanup of the N-Basin by the end of September 1997, but now anticipates completion by April 1, 1998.

The Board continues to monitor the progress on cleanup of the N-Basin. However, as BHI removes more of the debris and hardware from the basin, thereby significantly reducing the hazards, the Board intends to begin evaluating the degree of oversight necessary to perform its statutory role consistent with its Policy Statement 3 and its responsibilities as mandated by the Atomic Energy Act of 1954, as amended.

5. ADMINISTRATIVE MATTERS

5.1 PERSONNEL RECRUITMENT

By law, the Board is authorized to hire up to 150 full-time employees. As of December 31, 1997, it had a staff of 99 full-time employees, including two Site Representatives at the Pantex Plant, near Amarillo, Texas; two Site Representatives at the Hanford Site, in Richland, Washington; two Site Representatives at the Rocky Flats Environmental Technology Site, near Denver, Colorado; and two Site Representatives at the Savannah River Site, near Aiken, South Carolina.

The technical mission of the Board requires staff with multidisciplinary backgrounds and specialized engineering and scientific knowledge, and with demonstrated competencies in all major aspects of nuclear safety. The Board's technical staff includes individuals with extensive experience in nuclear, mechanical, electrical, chemical, structural, and metallurgical engineering and in physics. As an indication of the Board's technical talent, 21 percent of the technical staff hold degrees at the Ph.D. level, and an additional 66 percent have masters degrees. Most of the others, all of whom are college graduates, are technical interns who plan to complete their masters-level engineering programs within the next year. Moreover, almost all technical staff members, except interns, possess practical nuclear experience gained from duty in the U.S. Navy's nuclear propulsion program, the nuclear weapons field, or the civilian reactor industry. Five senior members of the Board's staff have law degrees (JD), in addition to degrees in a technical specialty. Both the Board and its staff include individuals experienced in environmental impact assessments and regulatory processes.

Staff expertise is supplemented on occasion by outside experts with special technical knowledge and extensive experience in the areas of plutonium processing, weapons assembly and disassembly, and other nuclear operations. Since the limited staff size precludes the ability to cover all scientific matters by means of in-house specialists, the Board contracts for specialized technical expertise as needed. Drawing on the work of the Board's technical staff and outside experts and utilizing their own considerable specialized knowledge and capabilities, the Board members have been able to make technical judgments and to serve as authors of the Board's recommendations and related actions.

Through its technical intern program, the Board has continued to recruit and develop a select group of the nation's top engineering graduates. Currently, six interns are in various phases of a 3-year training program encompassing formal graduate school education and on-the-job training. The outstanding academic and on-the-job performance of the five staff members that have already completed the intern program are proof of the effectiveness of these recruitment and selection methods. Board staffing projections include the recruitment of two technical interns in 1998.

5.2 OFFICIAL SITE VISITS BY BOARD MEMBERS AND STAFF

From the establishment of the Board in October 1989 through the end of 1997, the Board, its staff, and its contractor experts have collectively made more than 1200 site visits to DOE's defense nuclear facilities. In 1997 alone, 167 site visits were made. These visits focused primarily on selected facilities that both the Board and DOE consider to pose the most pressing issues in light of DOE's mission. Where appropriate, trip reports on staff visits have been conveyed formally to DOE managers.

During its visits to DOE sites, the Board has reviewed health and safety issues firsthand and gathered information relevant to its recommendations to the Secretary of Energy and the implementation of such recommendations.

5.3 INQUIRIES INTO HEALTH AND SAFETY ISSUES

During 1997, combined teams of legal and technical members of the Board's staff closed 5 and opened 14 new inquiries into health and safety issues at several defense nuclear facilities pursuant to 42 U.S.C. § 2286b(b). Inquiries were conducted at RFETS, ORNL, the Hanford Site, SRS, LANL, LLNL, the Pantex Plant, and the Fernald Site. Several of these inquiries produced significant improvement in practices or conditions that could adversely affect public health and safety and, in a few cases, affect national security missions conducted at DOE's defense nuclear facilities. Most of the lessons learned and corrective actions produced by these inquiries had application throughout the defense nuclear complex.

Through continuing review of DOE's infrastructure to protect safety-related structures, systems, and components from nonconforming or suspect/counterfeit parts, the Board's staff discovered a breakdown of DOE's response to an interagency alert issued by DoD regarding suspect/counterfeit electronic components sold to several federal agencies, including DOE. Intervention by the Board's staff provided DOE with legal, technical, and administrative assistance that enabled DOE to protect potentially compromised missions and to cooperate fully with Department of Justice actions. The Board's staff further intervened to ensure that appropriate safeguards and security measures were put in place to protect information resulting from the DoD investigation. The Board continues to work with DOE to ensure that lessons learned and needed corrective actions are fully implemented.

In response to an issue raised by a concerned individual, the Board's staff questioned whether the planned closure of a bridge at SRS would hinder emergency responses to site facilities. The Board's staff brought to DOE's attention the fact that site procedures did not require an examination of activities (e.g. those that might hinder emergency response) that occur outside facility fences for effects on the safety of the facilities. As a result of the Board's interest, DOE's Savannah River Operations Office requested that the contractor, Westinghouse Savannah River Company (WSRC) conduct an analysis to determine whether the bridge closure would

impede emergency responses. WSRC's review determined that the bridge closure would not unacceptably affect emergency responses or any authorization basis for site facilities. However, WSRC agreed to revise site procedures to ensure that site-wide activities outside facility boundaries are analyzed to determine potential effects on authorization bases for nuclear facilities, and accordingly did so. The revised procedures were subsequently used to analyze planned closure of two roads, disclosing that the road closures as planned would impede emergency responses. Based on this analysis, WSRC changed the sequence of the road closings.

A concern raised by a contract employee at Oak Ridge led the Board's staff to review the Final Safety Analysis Report addressing cylinders containing depleted UF_6 in storage yards at Oak Ridge K-25 and at the Portsmouth and Paducah Gaseous Diffusion Plants. The FSAR's analysis of a fire involving a cylinder handling vehicle indicated that the while the scenario is unlikely, the estimated releases of uranium and hydrogen fluoride would cause serious health consequences to nearby workers and to personnel at some locations beyond the site boundary. However, the FSAR did not identify preventive or mitigative controls for such an accident. In response to the Board's inquiry, DOE agreed to incorporate into the FSAR and Technical Safety Requirements a new set of controls, including (1) installation of fire-suppression equipment with engine shutdown interlocks on each of the cylinder handling vehicles, (2) turbocharger and exhaust thermal covers on each of the vehicles, (3) a limit on allowable fuel loading to one-half of the vehicle's fuel tank capacity, and (4) additional procedural and maintenance controls.

Early in this inquiry, the Board's staff determined that this matter also affected activities under the jurisdiction of the Department of Transportation and the Nuclear Regulatory Commission. Accordingly, those agencies were notified of the safety concerns and the Board's resolution of the matters within its jurisdiction.

5.4 PUBLIC INTERACTION WITH THE BOARD

The Board is sensitive to the need for public involvement in and awareness of defense nuclear safety issues. In its public health and safety reviews, the Board's contacts with the public are primarily through open hearings and easy access to the Board's technical documents through the Internet and the public reading room. Since 1990, the Board has held 58 public hearings at sites across the nation and in Washington, D.C. The public reading room is open to the public every working day. The staff has received numerous complimentary letters from private citizens, public interest groups, corporations, and other government agencies on the availability of technical and administrative documents.

The Board has found public meetings to be very effective tools for encouraging responsiveness on the part of DOE representatives, and for exchanging information with state and local officials, labor leaders, DOE facility workers, public interest groups, and area residents.

During 1997, the Board conducted six public hearings at its Washington, D.C., office. In addition to public meetings, members of the Board's staff have provided information briefings to local officials, citizens advisory boards, and other public interest groups in the vicinity of the Pantex Plant, and SRS, Hanford, and RFETS.

At four of the public meetings, the Board, its technical staff, and outside experts discussed the status of DOE's implementation plan for Recommendation 95-2 on Integrated Safety Management. One public meeting was held to examine DOE's progress on activities to initiate or accelerate programs to process and repackage surplus nuclear materials for storage as recommended in Recommendation 94-1. A meeting was also held to enlist public participation in drafting the Board's Strategic Plan, which was submitted to Congress under the Government Performance and Results Act.

Notices of such public Board meetings are published in the *Federal Register* and are mailed to more than 400 organizations and individuals that have requested to be on the Board's mailing list. In addition, each notice is published in local newspapers serving the communities near the facility involved, as well as being placed on the Board's Internet Web site.

As an efficient and cost-effective vehicle for communicating information, the Board's Internet Web site, has been expanded to include additional categories of information. The Web site, located at www.dnfsb.gov, provides among other items the entire text of all Board recommendations, biweekly updates of the log of correspondence/documents sent or received by the Board, and other background information on the Board's health and safety review activities. Recently, the Board expanded its database to include technical staff trip reports and weekly site representative reports. The Board's Web site has received several awards for its clarity, ease of use, and presentation of information.[12] As of the end of 1997, more than 20,000 "visits" to the Web site had been logged.

In accordance with Office of Management and Budget Bulletin No. 95-01, the Board has established and includes on the Web site its Government Information Locator Service to identify and describe public information resources available and to direct users on how to obtain this information.

5.5 NATIONAL PERFORMANCE REVIEW OBJECTIVES

The President has directed that all executive branch agencies review their individual legislative mandates and operations as an integral part of a fundamental rethinking of what the

[12] NetGuide and Places to See awards are given to Web sites based on content, presentation, and graphics. These two Web sites help guide users through the Internet and help users stay on top of the constantly changing Internet environment.

federal government should do and how it should be done. This program, under the direction of the Vice President, is called the National Performance Review.

The Board believes that as a relatively new agency, formed in November 1989, and not encumbered by years of bureaucratic rules, regulations, and practices, it has accomplished many of the streamlining objectives of the National Performance Review. At its inception, the Board recognized the importance of carefully structuring an organization that would avoid layering, promote empowerment, and encourage timely action. It has built a strong organization based on the successful implementation of the following initiatives.

5.5.1 Starting Without Encumbrances

The Board did not inherit any staff, organizational structure, or internal regulations governing the conduct of business. Therefore, it was free to create a lean organization tailored to its specialized scientific and technical mission, without the encumbrances often associated with traditional government operations, such as vertical layering, excessive administrative support, and duplication of function. The lean structure of its technical organization enables the Board to use technical staff members in an optimum way to address each new topic as it arises.

5.5.2 Reducing Regulatory Burden

The Board's policy on regulations is fully consistent with the President's memorandum on streamlining the bureaucracy. To date, the Board has promulgated only those internal regulations necessary to maintain orderly operations—related to the Freedom of Information Act, the Privacy Act, the Government in the Sunshine Act, and Organizational and Consultant Conflicts of Interest. Moreover, in promulgating these regulations, the Board has written the rules in ways that achieve the statutory purposes without burdening the Board or the public with inflexibility, or with overly prescriptive requirements that attempt to substitute excessive paperwork for sound judgment.

5.5.3 Excepted Service and Pay for Performance

The Board successfully argued for, and subsequently received through legislation and administrative delegations, the means to overcome many of the administrative roadblocks that have traditionally frustrated change in government organizations. Most prominent on this list of specific statutory authorities sought by the Board and ultimately granted by the Congress is the excepted service personnel authority.

The pay banding and pay for performance concepts recommended in the National Performance Review have been operational at the Board for more than 5 years and have received favorable review by the General Accounting Office and the Office of Personnel Management. These concepts have proven to be highly effective in hiring technical talent, holding employees accountable for their performance, and rewarding outstanding performance on the job.

5.5.4 "No Frills" Approach to Operations

From the first day of operation, the Board members have set a standard for having a "no frills" approach to conducting business. For example, the Board does not employ chauffeurs and has no government automobiles for local travel of Board members or staff. Internal directives have been written to give practical and easily understood guidance in the most simplified manner. The Board has converted to the Electronic Time and Attendance Management System (ETAMS) for recording of time and leave. All employees receive their salary checks by electronic funds transfer (EFT), and they are also encouraged to use EFT for travel reimbursements. Government credit cards are used extensively by the Board for official travel, telephone calls, and miscellaneous purchases. These initiatives have provided good customer service and reduced overhead costs.

5.5.5 Effective Organization Structure

The Board maintains focus on its mission regarding the adequate protection of public and worker health and safety at DOE defense nuclear facilities. Using a matrix form of organization, the Board has gained management flexibility and avoided the creation of layers of middle management that could dilute its limited staff resources and thereby impede its ability to perform health and safety reviews.

Adopting the philosophy of economies of scale for obtaining needed administrative support services, the Board has negotiated Interagency Agreements with the U.S. Nuclear Regulatory Commission, the Public Health Service, and the General Services Administration to obtain support for accounting, personnel, and payroll services. Resources that would normally be diverted to these administrative functions remain dedicated to the health and safety mission.

5.5.6 Management Continuity

Under the Board's enabling legislation, the five Board members are appointed to staggered 5-year terms on a full-time basis. Thus, the Board has enjoyed management continuity and has not been subjected to the disruption of frequent changes in leadership experienced by many government agencies. This has permitted the Board to provide precise and consistent direction for the conduct of its technical mission and major policy issues, as well as a degree of constancy and stability for DOE's upgrading efforts in safety management.

5.5.7 Information Technology

To improve communications with DOE field sites and to reduce travel time and expenses, the Board installed video teleconferencing equipment at its field locations. The Board has used this technology for the rapid exchange of information during briefing sessions with multiple DOE field sites on issues that impact the entire weapons complex. This technology enables the Board's Headquarters and field staff to receive briefings from DOE and its contractors with minimal

burden to DOE's staff. In 1997, the Board extended video teleconferencing capabilities to each of the four site representative locations at Rocky Flats, Hanford, Pantex, and Savannah River.

The Board maintains a high-speed connection to the Internet for all staff members, which allows technical and administrative staff to communicate via electronic mail with other federal and state agencies and members of the public. Staff members use their desktop computers to obtain the latest information on events at defense nuclear sites, to review draft DOE rules and orders, to participate in the exchange of information with professional societies, to perform research on technical subjects, to access notices and legal decisions, and to send draft reports to colleagues for review. In addition, technical staff on travel and site representatives have remote access to the Board's local area network through dial-in communications, and can retrieve and send files, review electronic mail, and communicate with colleagues at headquarters.

5.6 ETHICS PROGRAM

Among its other duties, the Office of General Counsel conducts the ethics program for the Board. During 1993, and again in 1996–97, the U.S. Office of Government Ethics conducted triennial audits of the Board's ethics program. The auditors found the program to be superior in all respects. As an outcome of the audit, the Board's Ethics Program was given the Office of Government Ethics Award of Excellence for outstanding achievements in developing and managing the ethics program.

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APPENDIX A. *FEDERAL REGISTER* NOTICES FOR RECOMMENDATION 97-1 AND RECOMMENDATION 97-2

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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

[Recommendation 97-1]

Safe Storage of Uranium-233

AGENCY: Defense Nuclear Facilities Safety Board.

ACTION: Notice; recommendation.

SUMMARY: The Defense Nuclear Facilities Safety Board has made a recommendation to the Secretary of Energy pursuant to 42 U.S.C. 2286a concerning the Safe Storage of Uranium-233. The Board requests public comments on this recommendation.

DATES: Comments, data, views, or arguments concerning this recommendation are due on or before April 10, 1997.

ADDRESSES: Send comments, data, views, or arguments concerning this recommendation to: Defense Nuclear Facilities Safety Board, 625 Indiana Avenue, NW., Suite 700, Washington, DC 20004-2901.

FOR FURTHER INFORMATION CONTACT: Kenneth M. Pusateri or Andrew L. Thibadeau at the address above or telephone (202) 208-6400.

Dated: March 6, 1997.

John T. Conway,

Chairman.

[Recommendation 97-1] Safe Storage of Uranium-233

Dated: March 3, 1997.

Approximately one ton of Uranium-233 (^{233}U), a man-made isotope of uranium, was produced by the Department of Energy (DOE) and its predecessor agencies. This material has been studied extensively, and uses were found for it in DOE's defense-related applications and in nuclear reactor programs supported both by DOE and commercial companies. The ^{233}U in this country is now all in the possession of DOE. It is presently stored at several DOE sites, predominantly within defense nuclear facilities under the purview of the Defense Nuclear Facilities Safety Board (Board). Almost all of the ^{233}U has been determined by DOE to be excess to its needs, and with minor exceptions it is regarded as legacy material. As will be apparent from the following, however, any future

processing or disposal of the ^{233}U will be accompanied by deep problems which will cause handling of the relatively small inventory of this material to be exceptionally difficult.

Most of this material in DOE storage has a specific alpha-activity which approaches that of weapons grade plutonium. Furthermore, all ^{233}U contains an amount of ^{232}U which varies from one lot to another. One of the daughter products in the radioactive decay chain of the ^{232}U is Thallium-208 (^{208}Th). That isotope of Thallium emits a high-energy (2.6 Mev) gamma ray when it decays. Depending on the amount of ^{232}U present in the ^{233}U, the surrounding radiation field can vary from somewhat less than one Rem/hr to several tens of Rem/hr. This radiation field causes handling and processing of any single item to be highly hazardous and very difficult to perform. Even visual inspection of a container housing ^{233}U will usually be difficult.

DOE has recently completed a review of issues associated with highly-enriched uranium. The results of that review have been made available to the Board in a report entitled the Highly Enriched Uranium Environmental, Safety and Health Vulnerability Assessment Report. This report stated that ^{233}U in storage exists in various forms throughout the complex, including metal, compounds, and scrap material. In addition, it noted that there was uncertainty as to the identity of some of the items and the material condition of many of the storage containers. Members of the Board's staff have also recently reviewed the storage of ^{233}U. The results of that review have been issued by the Board as the report "Uranium-233 Storage Safety at Department of Energy Facilities" (DNFSB/TECH-13). The assessments in that report have led the Board to identify several areas of concern.

Responsibility for the ^{233}U inventory remaining within the DOE complex is diffuse. Several secretarial officers and office heads are responsible for aspects of defense nuclear facilities that store significant quantities of ^{233}U. For example, Defense Programs is responsible for Building 3019 at the Oak Ridge National Laboratory, where more than 400 kg of ^{233}U resides. Environmental Management now has responsibility for the Chemical Processing Plant and the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory, where there are about 350 kg of unirradiated ^{233}U in various chemical and physical forms and a large number of irradiated nuclear fuel elements. An additional complication results from the role of DOE's Office of Material Disposition in developing strategies for final disposal of excess special nuclear material. By way of contrast to this state of dispersed responsibility, the Board notes the better practice of placing stabilization of plutonium residues under a single project manager, in response to the Board's Recommendation 94-1.

Uncertainty as to the condition of many items of stored ^{233}U generates additional concerns. Review of the original storage and packaging of the items of ^{233}U reveals wide variations in practices. Questions exist in some cases as to the original state and composition of stored items. Furthermore, many of the containers in which U-233 is stored have not been inspected for decades, and in some cases have not even been accessed over this interval. The inactivity leads to additional doubts as to the condition of the stored material, and degrades even further the information base which should be improved before it becomes necessary to process the contents of the containers for ultimate disposal. It also raises questions as to how the storage facilities themselves can be deactivated, cleaned up, and decommissioned, since some will be contaminated with this highly radioactive material.

It cannot be ruled out that problems exceeding those which motivated the Board in issuance of its Recommendation 94-1 may be found where ^{233}U is stored under conditions such that physical deterioration can occur. For this reason it would appear prudent to assess the adequacy of packaging of the items of ^{233}U as they are presently stored, as well as the state of the storage facilities, and to correct any problems that are found. The assessment would profit from the example of DOE's implementation of the Board's Recommendation 94-1, in developing a standard for the interim packaging and storage of plutonium. A similar standard would probably be appropriate for ^{233}U, but some differences may be called for.

The Board understands that work is presently on-going within DOE to address some of the above concerns. However, actions to deal with DOE's remaining inventory of U-233 would be greatly enhanced by a more systematic and focused approach. Therefore, the Board recommends that DOE:

1. Establish a single line project to deal with issues attached to safe storage of ^{233}U.

2. Develop standards to be used for packaging, transportation, and interim and long-term storage of ^{233}U.

3. Characterize the items of ^{233}U presently in storage in DOE's defense nuclear facilities, as to material, quantity, and type and condition of storage container.

4. Evaluate the conditions and appropriateness of the vaults and other storage systems used for the ^{233}U at DOE's defense nuclear facilities.

5. Assess the state of storage of the items of ^{233}U in light of the standards mentioned in recommendation 2 above.

6. Initiate a program to remedy any observed shortfalls in ability to maintain the items of ^{233}U in acceptable interim storage.

7. Establish a plan for the measures that can eventually be used to place the ^{233}U in safe, permanent storage.

8. Until these ultimate measures are taken, ensure that the DOE complex retains the residue of technical knowledge and competence needed to carry through all of the measures needed to ensure safe storage of the ^{233}U in the short and the long term.

John T. Conway,

Chairman.

Appendix—Transmittal Letter to Acting Secretary of Energy

Defense Nuclear Facilities Safety Board

March 3, 1997.

The Honorable Charles B. Curtis,
Acting Secretary of Energy, 1000 Independence Avenue, SW, Washington, DC 20585-1000

Dear Mr. Curtis: On March 3, 1997, the Defense Nuclear Facilities Safety Board (Board), in accordance with 42 U.S.C. § 2286a(a)(5), unanimously approved Recommendation 97-1 which is enclosed for your consideration. Recommendation 97-1 deals with the Safe Storage of Uranium-233.

42 U.S.C. § 2286d(a) requires the Board, after receipt by you, to promptly make this recommendation available to the public in the Department of Energy's regional public reading rooms. The Board believes the recommendation contains no information which is classified or otherwise restricted. To the extent this recommendation does not include information restricted by the Department of Energy under the Atomic Energy Act of 1954, 42 U.S.C. §§ 2161-68, as amended, please arrange to have this recommendation promptly on file in your regional public reading rooms.

The Board will publish this recommendation in the Federal Register.

Sincerely,

John T. Conway

Chairman

Enclosure: c: Mr. Mark B. Whitaker, Jr.

[FR Doc. 97-5961 Filed 3-10-97; 8:45 am]

BILLING CODE 3670-01-M

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

[Recommendation 97-2]

Continuation of Criticality Safety at Defense Nuclear Facilities in the Department of Energy (DOE) Complex

AGENCY: Defense Nuclear Facilities Safety Board.

ACTION: Notice; recommendation.

SUMMARY: The Defense Nuclear Facilities Safety Board has made a recommendation to the Secretary of Energy pursuant to 42 U.S.C. 2286a concerning continuation of critically safety at defense nuclear facilities in the Department of Energy (DOE) complex.

DATES: Comments, data, views, or arguments concerning this recommendation are due on or before June 30, 1997.

ADDRESSES: Send comments, data, views, or arguments concerning this recommendation to: Defense Nuclear Facilities Safety Board, 625 Indiana Avenue, NW, Suite 700, Washington, DC 20004-2901.

FOR FURTHER INFORMATION CONTACT: Kenneth M. Pusateri or Andrew L. Thibadeau at the address above or telephone (202) 208-6400.

Dated: May 21, 1997.

John T. Conway,

Chairman.

Continuation of Criticality Safety at Defense Nuclear Facilities in the Department of Energy (DOE) Complex

May 19, 1997.

In the first two or three decades following the Manhattan Project, nearly every laboratory of the Atomic Energy Commission (AEC) had an active program addressing some phase of the physics of neutron chain-reacting systems. Each such study included a balance of experiment and theoretical analysis, as in common in engineering research. Some of the programs supported the design of nuclear weapons, some were directed at the design of nuclear reactors, and some were conducted simply as basic engineering research.

As a result of these programs, expertise in neutron chain-reacting systems was widespread; there was an abundance of individuals skilled in achieving and controlling neutron chain reactions. These individuals usually became expert as well in methods of avoiding a chain reaction when this is not desired. The state of a self-sustaining chain reaction is commonly called "criticality." Guidance by these knowledgeable individuals helped establish an admirable record of criticality safety in the many programs the AEC conducted with fissionable material. While occasional accidental criticality did occur at the peace of AEC activity, it seldom caused injury to workers, and never led to radiation affecting individuals off site. Furthermore, the last such instance of inadvertent criticality in the United States occurred about 20 years ago.

Some criticality research continued to replenish the supply of these experts through the era of the Energy Research and Development Administration (ERDA) and into the period of the Department of Energy (DOE), though at a steadily reduced rate. Today there is almost no theoretical research in criticality being conducted, although university courses continue to instruct students in the theoretical expertise that has already been developed. However, most of the early experts in criticality safety control were drawn from experimental research programs. For a number of years, the DOE complex placed its reliance for criticality safety on the diminishing number of such criticality control experts developed in earlier years. Recently, however, DOE has been forced to supplement that group with engineers trained on the job in the conduct of criticality calculations. The latter group contains few individuals who have conducted critical mass experiments. Thus collectively they have little practical experience

pertinent to avoiding chain reactions in nonreactor environments.

In 1993, the Defense Nuclear Facilities Safety Board (Board) sensed that the source of experimental competence in prevention of inadvertent criticality was in danger of being lost entirely as a result of DOE's impending closure of this last critical mass facility in the country. That closure would have ended the hands-on education of new generations of scientists and engineers in the properties and behavior of critical systems. However, expertise in criticality safety will continue to be needed as long as fissionable material is used and stored. The Board viewed the end of experimental criticality studies as a threat to criticality safety in future DOE activities, and issued Recommendations 93–2, which advised against such action. As stated in that Recommendation,

> The Board believes it is important to maintain a good base of information for criticality control, covering the physical situations that will be encountered in handling and storing fissionable material in the future, and to ensure retaining a community of individuals competent in practicing the control.

The Secretary accepted Recommendations 93–2 on May 12, 1993, noting the importance of (1) improving and maintaining a criticality control information base, especially to support future operations in handling, processing, and storage or disposal of fissionable material; (2) retaining a cadre of individuals competent in practicing criticality control and safety; (3) continuing an experimental program; (4) continuing an education program for criticality safety professionals; (5) coordinating the criticality program among various users; (6) performing a criticality assessment with respect to defense nuclear facilities to determine the scope of current and future requirements for criticality experiments, predictability, and training, and (7) investigating the mission requirements, program funding, and landlord issues.

Since Recommendation 93–2 was issued, DOE has made substantial progress in coordination and implementation of the criticality experiments program. Funding for the program has stabilized, albeit at a low level, and work has been initiated on a prioritized list of experiments. However, a basic set of problems continues to exist throughout the DOE complex with regard to criticality control. Among the problems are the following:

1. In the past, it was found that only a few experienced criticality engineers were needed to guide criticality safety at even the most complex facilities. However, at the majority of DOE facilities where accidental criticality is currently a potential issue, the number of engineers assigned to criticality control is surprisingly large. The Typical criticality safety staff consists mainly of individuals who have no prior first-hand experience in criticality, and who have been trained on the job in analytical aspects of criticality control after being hire. They lack background in neutron physics on a fundamental level, and are not familiar with work on assemblies near the critical state, activities that would foster intuitive approaches to criticality control. Therefore, when faced with the need to determine what must be done to avoid a chain reaction, they most frequently fall back on complex multidimensional Monte Carlo calculations. Their use of simplified methods and their reliance on published data are minimal. The Board points out that complex analysis may be needed for some cases, such as those with difficult geometry, but such analysis is time-consuming and may dramatically slow preparation for the activities being evaluated.

2. Operational practices at some DOE facilities place criticality control in a central position in operations, with the criticality engineer establishing certain aspects of operation for safety reasons. Effectively, the criticality engineer, with all the shortcomings described in 1 above, becomes the critical path for line management. This causes delays in the ability of the line management to develop overall safety requirements.

3. In the past, most of the criticality safety data in guidance documents has been directed to activities involving production of nuclear weapons. The guidance has incorporated data from several experimental programs established to ensure avoidance of unintentional criticality in weapons programs. The experimental data has often been generalized by analysis of the experimental results and by theory benchmarked against experiments. The missions of DOE have changed substantially, however, and guidance for other types of activities is not needed. It is particularly important that guidance be developed to help in analyzing the safety of cleanup operations and the handling, storage, and shipping of miscellaneous containers that include fissionable material mixed with other material.

The above problems have had a significant effect on the productivity of several DOE operations. They have adversely affected safety by extending the period of time required for meeting safety commitments, such as those responding to Board Recommendation 94–1. In so doing, they have absorbed resources potentially needed for other safety-related activities at DOE's defense nuclear facilities. In this light, the Board believes action should be taken to eliminate these problems and to ensure that criticality safety can continue to be achieved efficiently in DOE's future operations.

Therefore the Board recommends that DOE:

1. Restructure the program of experimental research in criticality established under the Implementation Plan for Recommendation 93–2 to emphasize determination of bounding values for criticality of systems most important in the current programs at DOE facilities.

2. Organize the records of calculations and experiments conducted to ensure the criticality safety of DOE's past operations so as to provide guidance for criticality safety in similar situations in the future and avoid repetition of past problems.

3. Establish a program to interpolate and extrapolate such existing calculations and data as a function of physical circumstances that may be encountered in the future, so that useful guidance and bounding curves will result.

4. Collect and issue the experimental and theoretical data from the above in a publications as guidance for future activities.

5. Clarify in guidance that simple, bounding methods of analysis can be used in place of specific theoretical analysis in setting criticality limits for processes, and that limits derived in this manner are even preferable where they serve the purpose. The decreasing order of preference should be experimental data, theory benchmarked against experimental data, and nonbenchmarked criticality analysis with an adequate safety margin.

6. Develop and institute a short but intensive course of instruction in criticality and criticality safety at DOE's criticality experiments facility to serve as the foundation for a program of formal qualification of criticality engineers. This course should instill in students a familiarity with the factors contributing to criticality, the physical behavior of systems at and near criticality, and a theoretical understanding of neutron multiplication processes in critical and subcritical systems. A goal would be for reliance for criticality safety at any DOE facilities to rest in a group of individuals endowed with such experience.

7. Where not already done, assign criticality safety as a staff function

assisting line management, with safety responsibility residing in line management.

8. Identify a core group of criticality experts experienced in the theoretical experimental aspects of neutron chain reactions to advise on the above steps and assist in resolving future technical issues.

9. Organize funding of the criticality research and instruction program to improve its stability and to recognize the cross-cutting importance of this activity.

John T. Conway,

Chairman.

[FR Doc. 97-13977 Filed 5-28-97; 8:45 am]

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APPENDIX B - RESUME OF BOARD MEMBER DR. JOHN E. MANSFIELD
APPOINTED NOVEMBER 3, 1997

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APPENDIX B - RESUME OF BOARD MEMBER DR. JOHN E. MANSFIELD

On November 3, 1997, Dr. John E. Mansfield was sworn in as a member of the Board. Dr. Mansfield is an accomplished theoretical physicist with broad experience both within and outside government. He brings to the Board his interests and experience in physics, engineering, risk assessment, operations analysis, and political-military studies in support of the national defense.

Dr. Mansfield started his career as a senior scientist with Science Applications International Corporation, where he was a principal investigator and a contributor to various research projects in the areas of nuclear weapons effects and probabilistic risk assessment for commercial nuclear power plants.

His government service began with the Defense Intelligence Agency, where he served as Chief of the Nuclear Energy and Applied Sciences Division In that position he was responsible for advising defense policy makers on foreign technical capabilities and developments of military significance. During his service with the Agency he introduced several innovative programs for analyzing Soviet strategic capabilities which had significant impact at the highest levels of defense policy.

Subsequently, Dr. Mansfield joined the Defense Nuclear Agency. There, he served as Assistant to the Deputy Director (Science and Technology) for Theoretical Research, responsible for planning a large research program covering aerospace system vulnerability and hardening, lethality of strategic defense weapon concepts, survivability and security of nuclear weapons in the theater, nuclear radiation simulator development, and development of technical support aids for theater nuclear forces.

Dr. Mansfield has also served in the legislative branch of the federal government. He was a member of the professional staff of the House Armed Services Committee, responsible for preparing technical and budgetary advice for the Research and Development, Procurement, and Arms Control subcommittees. Later, after serving at the Defense Advanced Research Projects Agency (DARPA), Dr. Mansfield joined the professional staff of the Senate Armed Services Committee, where he was responsible for preparing scientific, technical, budgetary, and policy recommendations for the minority members of the Subcommittee on Strategic Forces and Nuclear Deterrence.

At DARPA, Dr. Mansfield held the position of Chief Scientist. His responsibilities included the technical review of innovative technologies in mathematics, materials, electronics, geophysics, directed energy, computer sciences, surveillance technologies, space physics, and aeronautics. He was the primary point of contact between DARPA and the scientific and academic communities and was responsible for monitoring relevant technology advances for incorporation into new agency programs. In an earlier assignment at DARPA, Dr. Mansfield had

been the Director of the Strategic Technology Office, responsible for the planning, budgeting, and execution of technology development and demonstration programs in support of future national strategic programs, both offensive and defensive.

Before his appointment to the Board, Dr. Mansfield was Associate Administrator of NASA, with responsibility for the Office of Space Access and Technology. In this position he was responsible for NASA research on future space technologies, future launch systems, support for commercial use of the Space Station and Shuttle, the NASA Small Business Innovative Research program, and technology transfer.

Dr. Mansfield has served on a number of high-level committees, working groups, and task forces. He is the author of more than fifteen published papers, technical reports, and reviews. His advanced degrees include a Master of Science in physics and a Licentiate in philosophy from St. Louis University, and a Master of Arts and Doctor of Philosophy from Harvard University.

APPENDIX C. LIST OF ABBREVIATIONS AND ACRONYMS

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LIST OF ABBREVIATIONS AND ACRONYMS

ACB . . . . . Auxiliary Charcoal Bed
ACRR . . . . . Annular Core Research Reactor
APSF . . . . . Actinide Packaging and Storage Facility
APT . . . . . Accelerator Production of Tritium
BHI . . . . . Battelle Hanford, Inc.
BIO . . . . . Basis for Interim Operation
Board . . . . . Defense Nuclear Facilities Safety Board
CERCLA . . . . . Comprehensive Environmental Response, Compensation, and Liability Act
CMIP . . . . . Capabilities Maintenance and Improvement Project
CMR . . . . . Chemical and Metallurgical Research (Facility)
CPP-603 . . . . . Chemical Processing Plant-603 (at Idaho National Engineering and Environmental Laboratory
CRD . . . . . Contractor Requirements Document
DAF . . . . . Device Assembly Facility
DARPA . . . . . Defense Advanced Research Projects Agency
DBE . . . . . Design Basis Earthquake
DEAR . . . . . Department of Energy Acquisition Regulations
DoD . . . . . Department of Defense
DOE . . . . . Department of Energy
DOE-AL . . . . . Albuquerque Office of the Department of Energy
DOE-RL . . . . . Richland Office of the Department of Energy
DOE-SR . . . . . Savannah River Office of Department of Energy
DP-20 . . . . . Deputy Assistant Secretary of Energy for Military Applications and Stockpile Support
EFT . . . . . Electronic Funds Transfer
EH . . . . . DOE's Office of Environment, Safety, and Health
EIS . . . . . Environmental Impact Statement
EM . . . . . DOE's Office of Environmental Management
EPA . . . . . Environmental Protection Agency
ES&H . . . . . Environment, Safety, and Health
ETAMS . . . . . Electronic Time and Attendance Management System
ETTP . . . . . East Tennessee Technology Park
EUO . . . . . Enriched Uranium Operations
FRAM . . . . . Functions, Responsibilities, and Authorities Manual
FSAR . . . . . Final Safety Analysis Report
FSU . . . . . First Surveillance Unit
GPRA . . . . . Government Performance and Results Act (of 1993)
GTS . . . . . Gas Transfer System

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

HAR . . . . . Hazards Analysis Report
HCF . . . . . Hot Cell Facility
HE . . . . . High Explosive
HEU . . . . . Highly Enriched Uranium
HIVES . . . . . Highly Invulnerable Encased Safe
INEEL . . . . . Idaho National Engineering and Environmental Laboratory
IPP . . . . . Integrated Program Plan
ISM . . . . . Integrated Safety Management
ISMS . . . . . Integrated Safety Management System
ISP . . . . . Integrated Safety Process
ITP . . . . . In-Tank Precipitation (Facility)
K-H . . . . . Kaiser-Hill
LAAO . . . . . Los Alamos Area Office of the Department of Energy
LANL . . . . . Los Alamos National Laboratory
LCAM . . . . . Life Cycle Asset Management
LINAC . . . . . Linear Accelerator
LLNL . . . . . Lawrence Livermore National Laboratory
LMES . . . . . Lockheed Martin Energy Systems
M&I . . . . . Management and Integration
M&O . . . . . Management and Operating
MAR . . . . . Material at Risk
MSRE . . . . . Molten Salt Reactor Experiment
MWTF . . . . . Multi-function Waste Tank Facility
NESE . . . . . Nuclear Explosive Safety Evaluation
NESS . . . . . Nuclear Explosive Safety Study
NESSCAP . . . . . Nuclear Explosive Safety Study Corrective Action Plan
NFPA . . . . . National Fire Protection Association
NIOSH . . . . . National Institute of Occupational Safety and Health
NMSF . . . . . Nuclear Materials Storage Facility
NNR . . . . . Non-Nuclear Reconfiguration (Program)
NRC . . . . . Nuclear Regulatory Commission
NTS . . . . . Nevada Test Site
OIP . . . . . Operational Improvement Program
ORNL . . . . . Oak Ridge National Laboratory
ORR . . . . . Operational Readiness Review
PFP . . . . . Plutonium Finishing Plant
PNNL . . . . . Pacific Northwest National Laboratory
Pu-238 . . . . . Plutonium-238
Pu-242 . . . . . Plutonium-242
QE . . . . . Qualification Evaluation

LIST OF ABBREVIATIONS AND ACRONYMS (concluded)

R&D . . . . . Research and Development
RCRA . . . . . Resource Conservation and Recovery Act
RFETS . . . . . Rocky Flats Environmental Technology Site
RFFO . . . . . Rocky Flats Field Office of the Department of Energy
RIF . . . . . Reduction in Force
ROD . . . . . Record of Decision
RSO . . . . . Reservoir Surveillance Operation
RTF . . . . . Replacement Tritium Facility
SAR . . . . . Safety Analysis Report
SIRR . . . . . Single Independent Readiness Review
SMIT . . . . . Safety Management Integration Team
SNFP . . . . . Spent Nuclear Fuel Project
SNL . . . . . Sandia National Laboratories
SNM . . . . . Special Nuclear Material
SPRF . . . . . Sandia Pulsed Reactor Facility
SRS . . . . . Savannah River Site
SS-21 . . . . . Seamless Safety-21 (process)
SSC . . . . . Structures, Systems, and Components
TA-3 . . . . . Technical Area-3
TA-55 . . . . . Technical Area-55
TEF . . . . . Tritium Extraction Facility
TRU . . . . . Transuranic (Waste)
TSR . . . . . Technical Safety Requirement
TWRS . . . . . Tank Waste Remediation System
U-233 . . . . . Uranium-233
U-235 . . . . . Uranium-235
UF_6 . . . . . Uranium Hexafluoride
WESF . . . . . Waste Encapsulation Storage Facility
WIPP . . . . . Waste Isolation Pilot Plant
WSRC . . . . . Westinghouse Savannah River Company