Department of Energy
National Nuclear Security Administration
Washington, DC 20585

July 13, 2010

OFFICE OF THE ADMINISTRATOR

The Honorable Peter S. Winokur
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

By the direction of the Secretary of Energy, the enclosed is the Department's Implementation Plan (Plan) for Defense Nuclear Facilities Safety Board (Board) Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*.

The Plan provides the Department's approach for implementing near-term actions to reduce the consequences of seismically-induced events at the Los Alamos National Laboratory Plutonium Facility, and longer-term actions to ensure continued safe operation of the facility.

Mr. James J. McConnell, Assistant Deputy Administrator for Nuclear Safety and Operations, Office of Defense Programs, NNSA, is the Department's responsible manager for ensuring that the Plan is successfully implemented. If you have any questions on the Plan, please contact Mr. McConnell at (202) 586-4379.

Sincerely,

Thomas P. D'Agostino
Administrator

Enclosure

U. S. Department of Energy

Implementation Plan
for
Defense Nuclear Facilities Safety Board
Recommendation 2009-2

Los Alamos National Laboratory
Plutonium Facility Seismic Safety

Washington, DC 20585

July 2010

Executive Summary

On October 26, 2009, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2009-2, *"Los Alamos National Laboratory Plutonium Facility Seismic Safety."* The Recommendation states that the mitigated off-site consequences to the maximally exposed offsite individual (i.e., the public) predicated on a seismically-induced large fire at the Los Alamos National Laboratory (LANL) Plutonium Facility (PF-4) would exceed the Department of Energy's (DOE) Evaluation Guideline of 25 rem by more than two orders of magnitude.

The Department of Energy shares the DNFSB's concerns and has been responsive to these concerns, as evident from the extensive list of near-term actions already taken and those planned for this calendar year, as summarized in this Implementation Plan. Risk is a function of frequency and consequence. The Department of Energy prefers to prevent an accident (i.e., by reducing its frequency) over mitigating its consequences after it has occurred. The assumed large initiating earthquake for this scenario has a frequency of occurrence of less than once in a thousand years. When addressing this accident scenario in 2008, the LASO safety evaluation report concluded that continued operation was justified because of the low frequency and planned near-term improvements. In December 2009, Los Alamos National Security (LANS) submitted an updated PF-4 safety basis, which stated that the calculated dose to the maximally exposed off-site individual is a factor of 15 below that presented in 2008; LASO is currently evaluating this safety basis update. The result is still a factor of 8 above the 25 rem Evaluation Guideline. The calculated dose is largely driven by three processes that constitute only 11 percent of the plutonium mass but contribute 85 percent of the calculated dose.

NNSA will use the 2009 safety basis to inform decisions for further reducing the frequency and consequences for seismically-induced events. Seismically-qualified active confinement ventilation is part of the suite of mutually supporting controls being pursued and, per the Implementation Plan for DNFSB Recommendation 2004-2, *Active Confinement Systems,* "active confinement ventilation systems can provide added safety benefit and are normally the preferred alternative when a building confinement safety function is needed to provide adequate protection to the public or collocated workers." The full suite described in this Implementation Plan includes: fire barriers, ignition source reduction, combustible loading controls, radioactive material containerization, material-at-risk controls, active confinement ventilation, seismically-qualified glove-box support stands, and fire suppression.

According to this Implementation Plan, by September 2011, PF-4 will have an approved refined accident analysis and controls for this scenario that either demonstrate mitigated consequences are well below the Evaluation Guideline or an executable strategy to achieve mitigated consequences that no longer challenge the Evaluation Guideline. This includes a project execution plan with identified funding to complete a set of upgrades that ensure mitigated consequences no longer challenge the Evaluation Guideline.

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1.0 BACKGROUND

1.1 Recommendation 2009-2

On October 26, 2009, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 2009-2, *"Los Alamos National Laboratory Plutonium Facility Seismic Safety."* The Recommendation states that the mitigated off-site consequences to the maximally exposed offsite individual (i.e., the public) predicated on a seismically-induced large fire at the Los Alamos National Laboratory (LANL) Plutonium Facility (PF-4) would exceed the Department of Energy's (DOE) Evaluation Guideline of 25 rem by more than two orders of magnitude.

Recommendation 2009-2 states that a major deficiency exists in the PF-4 safety basis approved in December 2008. In particular:

- It lacks appropriate compensatory measures to protect the public and workers;
- It relies inappropriately on planned seismic upgrades to safety systems that will not be implemented for many years and are not sufficient to address adequately the bounding seismic accident scenario; and
- The only safety feature that can be credited for these accident scenarios is the passive confinement provided by the facility structure.

Given the magnitude of the potential consequences to the public, the DNFSB recommended that DOE expeditiously develop a defensible safety strategy for seismically-induced events at PF-4, as well as develop a credible plan to implement that strategy that provides a definite, measurable, and immediate means to substantially reduce the potential consequences at the site boundary. The DNFSB specifically recommended that DOE:

1. Implement near-term actions and compensatory measures to reduce significantly the consequences of seismically induced events, including clear identification of consequence reduction targets/goals, schedule, and implementation methods (sub-recommendation 1); and

2. Develop and implement an acceptable strategy for seismically induced events that includes the following elements:

    a. A technically justifiable decision logic and criteria for evaluating and selecting safety-class structures, systems, and components that can effectively prevent or mitigate the consequences of seismic events to acceptably low values (sub-recommendation 2.a);

    b. The seismic analysis approach for structures, systems, and components required to implement the seismic safety strategy (sub-recommendation 2.b); and

c. A prioritized plan and schedule, including quarterly briefs to the DNFSB for the next 12 months, for seismic analyses, necessary upgrades, and other actions to implement the seismic safety strategy (sub-recommendation 2.c).

The DNFSB concluded that the severity of the problems and the urgency to remediate them argue forcefully for the Secretary to avail himself of his authority to "implement any such recommendation (or part of any such recommendation) before, on, or after the date on which the Secretary transmits the implementation plan to the Board…."

1.2 Department of Energy Analysis

The Department of Energy shares the DNFSB's concerns and has been responsive to these concerns, as evident from the extensive list of near-term actions already taken and those planned for Calendar Year 2010 (CY-10), summarized below.

In December 2008, LASO approved the first major upgrade to the PF-4 safety basis in 12 years. This was the culmination of an intense six-year effort by LASO, LANS, and the previous LANL contractor, the University of California. The LASO Safety Evaluation Report (SER), which provides the basis for LASO approval of the PF-4 safety basis, describes 20 analyzed accident scenarios with unmitigated consequences that challenge or exceed the Evaluation Guideline. All of these scenarios were explicitly shown to be mitigated below the 25 rem Evaluation Guideline except one – the evaluation basis earthquake with first floor fire. This is the scenario that the DNFSB identifies in the Recommendation as of most concern.

Overall, LASO judged that the nuclear safety advantages of approving the 2008 safety basis and initiating a broad range of nuclear safety improvements, outweighed the disadvantages presented by this one scenario. The SER stated that the postulated seismically-induced floor-wide fire would not be an acceptable result of the seismic event and must be reliably prevented.

Risk is a function of frequency and consequence. The Department of Energy prefers to prevent an accident (i.e., reducing its frequency) over mitigating its consequences after it has occurred. When addressing this scenario, the LASO SER observed that the assumed large initiating earthquake has an expected frequency of occurrence of less than once in a thousand years. The SER concluded that the probability of a floor-wide fire is successfully mitigated to beyond incredible based on a set of controls including but not limited to ignition source controls, combustible material controls, encapsulated heat sources, and the Performance Category 3 (PC-3) qualification of the building confinement and most storage systems.

The SER concluded that continued operation is justified because of the low frequency of a large seismic event and the planned near-term improvements. The SER required a comprehensive fire hazard analysis to be completed and integrated with the next annual

safety basis update; this would include effective and reliable combustible control procedures to reduce the frequency of a floor-wide fire. It also required that LANL submit an integrated project management plan to implement nearly two dozen planned improvements that, taken as a whole, will reduce risks associated with long-term PF-4 operations. The SER also required LANS to accelerate seismically upgrading a select set of glove-box support stands within three years; this would significantly reduce the material-at-risk that could be released within the facility and reduce the frequency of an incipient fire associated with these glove-boxes. Subsequently, LASO and LANS determined that the glove-box stand seismic upgrades could not be completed on the schedule required by the SER.

In October 2009, the DNFSB issued Recommendation 2009-2.

In December 2009, LANS submitted an updated PF-4 safety basis which calculated the dose to the maximally exposed off-site individual to be a factor of 15 below that presented in 2008; LASO is currently evaluating the proposed safety basis update. The result, 189 rem, is still a factor of 8 above the 25 rem Evaluation Guideline. The decrease was not unexpected. The scenario presented in the 2008 safety basis – upon which the DNFSB based Recommendation 2009-2 – assumed an initial condition analogous to 5 metric tons of molten plutonium, which exceeds the amount of molten plutonium that PF-4 can physically produce at one time by nearly two orders of magnitude.

The following Table compares the results from the 2008 safety basis to those in 2009. Both the 2008 and the 2009 safety bases credit the passive building envelope with decreasing leakage by 40 percent, thereby mitigating the consequences. The 2009 calculated dose consequence is lower because the first floor inventory is conservatively but more realistically assumed to be divided into six material forms in amounts that could physically exist in the facility, including 80 kg molten plutonium, 10 kg ball-milled heat-source plutonium powder, and 85 kg of plutonium in boiling or burning solutions. Collectively, these three components are driven by processes (e.g., melting plutonium, ball-milling heat-source plutonium powder) and constitute only 11 percent of the plutonium mass, but they contribute 85 percent of the calculated dose.

	2008 Safety Basis				2009 Safety Basis			
Assumed Material Form	**Material Fraction**	**Pu-equivalent Material Amount (kg)**	**Dose Fraction**	**Mitigated Off-site Dose Contribution (rem)**	**Material Fraction**	**Pu-equivalent Material Amount (kg)**	**Dose Fraction**	**Mitigated Off-site Dose Contribution (rem)**
Plutonium Heat-Source Powder (10 kg)					0.46	1,387	0.33	63
Molten Plutonium Metal	1	5,000	1	2,900	0.03	80	0.32	60
Boiling Solutions					0.03	80	0.16	30
Ignited Metal (including and oxide)					0.46	1,368	0.14	26
Burning Solvent Solutions					0.002	5	0.05	10
Non-reactive Plutonium Powder					0.03	80	0.002	0.4
Total	1.00	5,000	1.00	2,900	1.00	3,000	1.00	189

TABLE: Comparison of 2008 and 2009 Safety Basis Assumptions and Results

NNSA will use the 2009 safety basis to inform the decision making process for actions to take to further reduce the frequency and the consequence for the first-floor post-seismic fire scenario. Options that involve moving plutonium metal and oxide solely to address the extremely unlikely post-seismic fire scenario are being carefully evaluated to balance significant worker safety risk against the minimal calculated dose reduction that would result from such material movements. For example, a 10 percent reduction in weapons-grade plutonium on the first floor only results in a 2 percent (i.e., 3 rem) reduction in the calculated post-seismic fire dose.

Alternatively, ceasing mission-critical processes involving solutions, molten plutonium, and ball-milling would reduce the calculated dose to near the 25 rem Evaluation Guideline. However, near-term actions, described below, have and will further reduce the frequency of the seismically-initiated first-floor fire. Sensitivity analyses have also shown that there are several options that can be pursued in future safety basis updates that may individually or collectively reduce the calculated consequences by greater than an order of magnitude (i.e., to below the DOE Evaluation Guideline). Therefore, ceasing mission-critical processes is not warranted because of the impact of cessation on PF-4's national security mission, the sufficiently low frequency of a major seismic event and full floor fire, and the CY-10 initiatives that will substantially reduce this risk in a demonstrably satisfactory manner.

1.3 Principal Safety Issues

Based on the above, the Department of Energy considers that there are three principal safety issues that need to be addressed to fully resolve the DNFSB's concerns with the PF-4 post-seismic floor-wide fire scenario:

- Near-term actions need to be implemented to reduce significantly the consequences of a seismically-induced fire;

- The scenario's frequency needs to be demonstrably reduced by interrupting the accident sequence from progressing to a full-floor fire that couples to the material-at-risk; and

- For the long-term, the scenario's calculated consequence needs to be further reduced to sufficiently low values.

2.0 UNDERLYING CAUSES

The approved 2008 safety basis identified controls that reduced the probability of the post-seismic fire from developing to a full-floor fire, but it did not demonstrate that accident consequences would not challenge the 25 rem Evaluation Guideline. The approval action recognized that future annual safety basis updates were necessary for the safety basis to mature to fully address this accident scenario.

3.0 BASELINE PARAMETERS

The baseline assumptions that govern implementation of DNFSB Recommendation 2009-2 are the following:

- The timeliness of completing the long-term strategy for addressing seismically-induced fires in the Plutonium Facility depends upon securing adequate funding, including near-term expense funded projects, with any line item scope included within the TA-55 Reinvestment Project.

- Closure of this implementation plan can occur once NNSA has done the following:

    - Reviewed and approved a refined accident analysis and control selection for the seismically-induced events at PF-4 that either demonstrates that mitigated consequences are well below the DOE Evaluation Guideline or establishes an executable strategy to achieve mitigated consequences that no longer challenge the DOE Evaluation Guideline.

    - Issued a project execution plan that includes strategy, cost, scope, schedule, and identified funding sources to complete a set of upgrades that ensure

mitigated consequences for seismically-induced events at PF-4 no longer challenge the DOE Evaluation Guideline.

4.0 NEAR-TERM ACTIONS

The near-term actions include: (1) accomplishments completed to date; (2) Fiscal Year 2010 (FY-10) funding adjustments; and (3) additional actions to be completed in CY-10.

The Department of Energy considers that, collectively, these actions address the first sub-recommendation.

Accomplishments:

- Repackaged 60 Russian Product Containers (RPCs) of plutonium-238 that had pressure safety concerns into new safety class containers
- Retrieved and safely vented 40 legacy non-safety class plutonium-238 containers
- Replaced 195 high efficiency particulate air (HEPA) filters with 500°F-rated HEPA filters
- Upgraded selected hardware and software of the Facility Control System that ensures proper ventilation flow and differential pressures between ventilation zones
- Developed fire department pre-plans that contain the emergency response guidelines for the fire department and other first responders
- Developed a model of the existing ventilation system that can be used to evaluate system modifications for migrating to a safety class active confinement strategy
- Developed a hydraulic model of the fire suppression system which identified weaknesses that are being addressed and will be used to inform decision making for making this system safety class
- Relocated the forklift charging station (an ignition source) away from safety-related equipment
- Replaced vault sprinkler heads with lower-actuation-temperature heads that will respond sooner and limit the development of a vault fire
- Improved ground attenuation model for seismic ground motion, which reduced seismic loads
- Completed implementing the combustible control program procedure, and the removal of more than 11 tons of combustible material from the facility, primarily from first floor laboratory rooms
- Submitted the annual safety basis update for LASO approval on December 1, 2009

Funding Adjustments for FY-10:

- Provided additional $700K of container funding for new generation container development
- Provided additional $6M of Material Recycling and Recovery funding for repackaging and disposition of material

Additional Actions to be Completed in CY-10:

- Develop the design for an automatic seismic shutdown of laboratory room process electrical power to reduce electrical ignition sources
- Remove, lock-out or render inoperable, glove-box ignition sources that are no longer needed
- Procure and install six safes with manufacturer-backed fire ratings, to be used for special nuclear material storage. The safes will be anchored to Performance Category 3 requirements, and a safety basis page change will be submitted recommending a damage ratio to be assumed for containers in safes.
- Fire test at least one existing container design to establish a damage ratio, based on a LANS proposed and LASO accepted test plan establishing fire temperatures and durations
- Establish scope for seismically upgrading fire suppression. This includes delivering a component upgrade list, anchorage calculations, and fragility calculations to support conceptual design in FY-11.
- Establish scope for seismically upgrading key active confinement ventilation subsystems, similar to the fire suppression system, to support conceptual design in FY-11
- Correct an identified set of 16 fire hazard analysis deficiencies
- Develop conceptual design information for glove-box inertion or fire suppression.
- Assess the main PF-4 fire barrier penetrations and repair deficiencies that can be repaired using standard fire protection designs
- Assess and develop conceptual design information for creating two-hour fire-rated separation between the four main areas on the PF-4 main floor
- Robustly package or otherwise disposition greater than 250 kg plutonium-equivalent material
- Complete safety class encapsulation of the existing inventory of heat-source plutonium currently stored in RPCs.
- Accelerate seismic upgrades to support stands for higher-risk glove-boxes, with the objective of achieving near-complete designs in FY-10; this targets glove-boxes that contain significant heat-generating devices, ignition sources, or plutonium
- Implement a fire wall surveillance and maintenance program

5.0 ISSUE RESOLUTION

As identified previously, there are three principal safety issues that need to be addressed to fully respond to the DNFSB concerns regarding the PF-4 post-seismic floor-wide-fire scenario:

- Near-term actions need to be implemented to reduce significantly the consequences of a seismically-induced fire;

- The scenario's frequency needs to be reduced by interrupting the accident sequence from progressing to a full-floor fire that couples to the material-at-risk; and

- For the long-term, the scenario's calculated consequence needs to be further reduced to sufficiently low values.

This section is divided into four subsections that outline the strategy for addressing these issues and that align with the elements of the Recommendation.

> *Near-term Actions:* Implement near-term actions and compensatory measures to reduce significantly the consequences of seismically-induced events.
>
> *Decision Logic and Criteria:* Identify a technically justifiable decision logic and criteria for evaluating and selecting safety-class structures, systems, and components (SSC) that can effectively prevent or mitigate the consequences of seismic events to sufficiently low values.
>
> *Analysis Approach:* Identify the seismic analysis approach to SSCs required to implement the seismic safety strategy.
>
> *Prioritized Plan and Schedule*: Develop a prioritized plan and schedule, including quarterly briefs to the DNFSB for the next 12 months, for seismic analyses, necessary upgrades, and other actions to implement the seismic safety strategy.

The NNSA Assistant Deputy Administrator for Nuclear Safety and Operations, Office of Defense Programs, is responsible for completing and transmitting to the DNFSB all deliverables in this implementation plan.

5.1 Near-term actions to reduce significantly the consequences of a seismically-induced fire

Section 4.0 identifies 14 actions to be completed in CY-10 that, along with prior actions and LASO approval of the 2009 safety basis update for PF-4, will reduce the consequences of a seismically-induced fire by reducing the size of the postulated fire.

> **Milestone 5.1:** Near-term actions to reduce the consequences of a seismically-induced fire
>
> Deliverable 5.1: Documented completion of near-term actions from Section 4 of this implementation plan
>
> Due Date: December 2010

5.2 Decision Logic and Criteria

Sub-recommendation 2.a focuses on identifying a technically justifiable decision logic and criteria for evaluating and selecting safety-class SSCs that can effectively prevent or mitigate the consequences of seismic events to acceptably low values.

10 CFR 830, Subpart B, *Safety Basis Requirements*, specifies the requirements for the preparation of the PF-4 safety basis. The safety basis includes the Documented Safety Analysis that derives the hazard controls necessary to ensure adequate protection of workers, the public, and the environment, and demonstrates the adequacy of these controls to eliminate, limit, or mitigate identified hazards. LANS will prepare the PF-4 safety basis in accordance with and comply with the safe harbor of DOE-STD-3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* DOE-STD-3009 provides the foundational decision logic and criteria for evaluating and selecting safety-class SSCs to effectively prevent or mitigate the consequences of seismic events to the point that their mitigated consequences no longer challenge the DOE Evaluation Guideline. The next update of the PF-4 safety basis will include consideration of insights gained from completion of the near-term actions in Section 4 and the seismic analyses described below in Section 5.3.

DOE O 420.1B, *Facility Safety*, and associated guides and standards provide performance goals for seismic events and other natural phenomena hazards for new and existing facilities. Evaluations by the Seismic Analysis of Facilities and Evaluation of Risk (SAFER) Project will identify probabilities of failure for components evaluated that do not meet the performance goals. Options that will be considered include upgrading on a component basis, which is conservative but also costly, and upgrading from a system-wide perspective using a probabilistic or event tree approach; the latter may not only be more cost effective but also provide a better understanding of the effectiveness of selected controls to address seismic accident scenarios in the safety basis.

The next update of the PF-4 safety basis will build upon the 2009 update. Refinement from the 2008 to the 2009 safety basis reduced the mitigated dose to the maximally exposed offsite individual (public) by a factor of 15, from 2,900 rem to 189 rem. Further refinement is necessary. The 2009 analysis assumed the building leak-path factor is 40 percent, that the heat-source plutonium is all readily dispersible powder, and that the remaining plutonium (about 1.4 metric tons) is largely ignited solid metallic plutonium, instead of a mixture of metal, oxides, ceramics, etc. This is all assumed to be readily dispersed by an unconstrained floor-wide fire. Future refinement might consider, for example:

- A more representative, smaller fire would likely involve less metallic plutonium or boiling solutions and could reduce the weapons-grade contribution to dose by an order of magnitude;

- Containerization, material form, and more credit for agglomeration could reduce the heat-source plutonium component by an order of magnitude;

- Installation and credit for automatic door closures to support a lower building leak-path factor assumption might significantly reduce the leak path factor;

- Credit for decreased and robustly controlled combustible inventory, fire-rated barriers, the fire suppression system, and seismic shutoff of electrical loads could potentially reduce the size of the postulated post-seismic fire sufficiently to reduce the overall calculated dose by an order of magnitude; and

- Credit for active confinement ventilation, coupled with the fire suppression system to prevent failure by soot loading, could reduce the calculated consequences of a post-seismic fire.

Most likely, crediting several preventive and mitigative controls will be necessary to reduce the mitigated consequences of seismically-induced events to the point that the DOE Evaluation Guideline of 25 rem is no longer challenged. This is discussed further in Section 5.4.

Milestone 5.2.1: Refined unmitigated accident analysis for all seismically-induced events

Deliverable 5.2.1: Summary of unmitigated accident analysis for seismically-induced events, including scenario description, accident progression, assumptions, and unmitigated dose consequences

Due Date: November 2010

Milestone 5.2.2: Refined accident analysis and control selection in the safety basis update

Deliverable 5.2.2: LANS submittal of an updated safety basis, including refined accident analysis and control selection for seismically-induced events that demonstrates that mitigated consequences are well below the Evaluation Guideline or establishes an executable strategy to achieve mitigated consequences that no longer challenge the Evaluation Guideline. The technical basis for the safety basis update will include the decision logic and criteria for evaluating and selecting safety class structures, systems, and components.

Due Date: May 2011

Milestone 5.2.3: NNSA approval of the refined accident analysis and control selection

Deliverable 5.2.3: NNSA review and approval of the refined accident analysis and control selection for seismically-induced events that either demonstrates that mitigated consequences are well below the Evaluation Guideline or establishes an executable strategy to achieve mitigated consequences that no longer challenge the Evaluation Guideline.

Due Date: 60 days following completion of Deliverable 5.2.2

5.3 Seismic Analysis Approach

Sub-recommendation 2.b focuses on the seismic analysis approach to SSCs required to implement the seismic safety strategy.

LANS is currently evaluating the seismic response of selected PF-4 SSCs based on the increase in the seismic hazard in the 2009 update to the 2007 Probabilistic Seismic Hazard Analysis. This work is being performed as part of the SAFER Project. For PF-4, the SAFER Project scope has increased to include evaluation of the fire suppression system and active ventilation exhaust systems to determine seismic vulnerabilities that might prevent operability following a Performance Category 3 earthquake. In particular, the SAFER evaluation will provide the following: the change in risk for existing safety SSCs; the identification of existing SSCs that may need upgrade or replacement because they do not meet safety performance goals; and the in-structure response that can be used for the design and construction of new or upgraded PF-4 SSCs.

In order to quantify the change in risk, the SAFER Project will identify affected SSCs; identify the credited safety function and relate this to a structural limit or mechanical function; calculate the performance achieved using the current seismic hazard and compare it to performance goals; and recommend replacement or upgrade if the performance goals are not met. The PF-4 SAFER evaluation will include the passive confinement system and components (e.g., building structure and glove-box support stands); fire suppression; and ventilation subsystems and their supporting electrical distribution systems.

The structural evaluations will be performed in a series of cascading level of complexity, ranging up to non-linear analyses with probabilistic soil-structure interaction, and probabilistic estimates of capacities. Initial analysis will use code-standard elastic methods and will evolve in accordance with DOE-STD-1020 (2002), to account for inelastic energy absorption. If the structure does not meet performance goals based on linear elastic analyses, then non-linear analyses may be pursued. Existing systems and components will be evaluated by using DOE/EH-0545, *Seismic Evaluation Procedure for Equipment in U. S. Department of Energy Facilities,* when they fall within the seismic experience database, or otherwise by component specific evaluation. The project will rely heavily on the use of

an independent peer review panel of recognized experts in design and evaluation of nuclear safety-related SSCs for the Department of Energy.

Milestone 5.3.1: PF-4 SAFER Scope

Deliverable 5.3.1: This deliverable includes the following scope: (1) PF-4 Structural Analysis and Acceptance Criteria; (2) PF-4 Systems and Components, Analysis and Acceptance Criteria for fire suppression and active confinement ventilation; (3) Table of seismic analysis calculations with schedule; and (4) Seismic Equipment List providing systems and components included in the systems and components evaluations.

Due Date: September 2010

Milestone 5.3.2: Seismic structure, systems, and component reports

Deliverable 5.3.2: Final reports documenting seismic performance level and whether safety class SSCs meet the target performance goals in DOE-STD-1020. For those safety class SSCs that do not achieve desired performance, sufficient information will be included to allow retrofit and cost studies.

Due Date: May 2011

5.4 Prioritized Plan and Schedule

Sub-recommendation 2.c focuses on a prioritized plan and schedule, including quarterly briefs to the DNFSB for the next 12 months, for seismic analyses, necessary upgrades, and other actions to implement the seismic safety strategy.

The site's approach to addressing seismically-induced scenarios is to recognize that prevention is better than mitigation and that a combination of interdependent controls is required to address this scenario. Seismically qualified active confinement, as described in Recommendation 04-2, is part of the suite of mutually supporting controls that is being pursued. The full suite of improvements and their scheduled implementation includes the following and is further discussed below:

- Fire barriers, ignition sources, and combustible loading
- Containerization and material-at-risk controls
- Active confinement ventilation
- Glove-box support stands
- Fire suppression

5.4.1 Fire Barriers, Ignition Source Reduction, and Combustible Loading

Fire barriers and ignition source and combustible inventory controls are preventive controls, in that they prevent an incipient fire from evolving to the full-floor fire assumed in the 2008 and 2009 safety bases. Near-term actions completed have reduced combustible loading and ignition sources, thereby reducing the probability of the seismically-induced full-floor fire or, equivalently, reducing the size and thermal environment for the postulated fire that needs to be assumed in the next iteration of the accident analysis. These effects will be considered in the next annual update to the safety basis to demonstrate either that mitigated consequences are well below the Evaluation Guideline or to establish the strategy to achieve mitigated consequences that no longer challenge the Evaluation Guideline (Deliverables 5.1, 5.2.2, and 5.2.3).

The ignition source and combustible inventory controls are being robustly implemented by a permit-based system that includes daily inspections and ensures sustainability and effectiveness of the controls. Additional related actions planned during the next year will further improve PF-4's safety posture relative to the post-seismic fire scenario:

- By December 2010, planned activities will correct a set of deficiencies identified in the updated fire hazard analysis; assess and repair, as necessary, penetrations in the main PF-4 fire barrier; assess and develop conceptual designs to create two-hour fire-rated separation between the four main areas on the PF-4 first floor; and implement a fire wall surveillance and maintenance program (Deliverable 5.1).

- By December 2010, LANS will develop a conceptual design for glove-box inertion or fire suppression (Deliverable 5.1).

- By April 2011, LANS will install an automatic seismic shutdown capability for non-vital laboratory room electrical loads that will further reduce electrical ignition sources available to initiate the post-seismic fire (Deliverable 5.4.3).

5.4.2 Containerization and Material-at-Risk Controls

Fire-rated containerization and material-at-risk controls are preventive controls, in that they prevent a fire from directly coupling to a portion of the first floor's inventory of plutonium. Near-term actions will reduce the first-floor overall material-at-risk limit by 40 percent and will strengthen the first-floor material-at-risk controls, by material form. Additional actions planned during CY-10 will implement an improved storage system that includes fire-rated containers, and fire-rated and seismically-anchored safes. LANS will also complete safety-class encapsulation of heat-source plutonium now in RPCs and will robustly repackage or disposition greater than 250 kg plutonium equivalent material (Deliverable 5.1).

5.4.3 Active Confinement Ventilation

Active confinement ventilation is a mitigative control, in that it would mitigate the consequences to the public of a release due to a seismically-induced fire. The preventive controls mentioned elsewhere would either reduce the probability of the seismically-initiated fire or reduce the consequences by decreasing the fire and soot environment that might challenge the HEPA filters.

In 2006, LANS completed the PF-4 confinement ventilation system evaluation, a commitment under DNFSB Recommendation 04-2. Seismically upgrading the entire active confinement system would be prohibitively expensive and is also unnecessary. The evaluation concluded that one subsystem, the bleed-off system, should be sufficient to keep the building air pressure negative relative to the outside, thereby minimizing any release of radioactive material to the environment.

Early implementation focuses seismic upgrades to those required to provide the appropriate safety function (i.e., keeping the building differential air pressure negative with respect to the outside). This set of ventilation controls is still being determined. NNSA has approved evolving the glove-box exhaust (i.e., Zone 1), the basement exhaust, and the bleed-off subsystems and necessary support systems to safety-class due to several non-seismic accident scenarios. However, the bleed-off sub-system alone with its power and controls may be sufficient to function as the final engineered barrier to a radioactive release for the post-seismic fire event. Key passive components (i.e., filters, filter plenums, and some ductwork) are already qualified to seismic demand loads, as understood in the mid-1990s.

By March 2011, LANS will issue conceptual design information for seismically-qualified safety-class active confinement ventilation capability. This will include analysis of various options to achieve this capability, factoring in the results of the seismic SSC studies discussed in Section 5.3, as they are understood at that time (Deliverables 5.3.2 and 5.4.2).

5.4.4 Glove-box Support Stands

The glove-box support stands are a preventative control, in that they reduce the plutonium inventory that could be readily dispersed by toppling glove-boxes, followed by fire. The 2006 confinement ventilation system evaluation found that the bleed-off system alone would not provide sufficient dose reduction for the post-seismic fire scenario; it stated that additional seismic upgrades to about 100 glove-boxes would improve protection of the public. This became a fundamental motivation for the 2008 SER establishing a condition of approval for seismically upgrading glove-box support stands for glove-boxes that contain significant heat-generating devices, ignition sources, or plutonium. Subsequent evaluations have reduced the number of glove-boxes requiring seismic upgrades by more than half by removing or locking out ignition sources, re-examining the need for upgrades for glove-boxes with minor heat sources (e.g., low-temperature hot-

plates), and excluding molten plutonium furnace boxes that are scheduled to be removed from service within the next five years.

The remaining glove-boxes requiring seismic upgrades have also been reprioritized to improve the timeliness and efficiency of the upgrade installation and to allow stands for higher-risk glove-boxes to be upgraded earlier. The upgrades will occur in three overlapping phases under the TA-55 Reinvestment Project, Phase 2 (TRP-II). The initial phase was to consist of glove-boxes of different types in order to validate cost estimates. Instead, now the first two phases, affecting stands for 24 glove-boxes, will focus on adjoining glove-boxes that are not only higher risk but also share common utilities and have common interferences. This will improve overall efficiency by only requiring a single removal and reinstallation of glove-box interferences and utilities.

By July 2011, installation of upgrades for the first 10 glove-boxes should be started and design for the next 14 glove-boxes should be completed. Design will be close-coupled to the seismic evaluations discussed in Section 5.3 (Deliverables 5.3.2 and 5.4.4).

5.4.5 Fire Suppression

Fire suppression would be a preventive control, in that it limits both the size of the fire and the thermal and soot environment. The 2006 confinement ventilation system evaluation found that a safety-class active confinement system will require a safety-class fire suppression system, because of the potential for soot loading overwhelming the HEPA filters, and questioned how long an active confinement system could operate under large fire conditions involving the most common shield materials used for plutonium operations. It concluded that a combination of controls should be considered to reduce the overall risk to the public for a wider range of accident scenarios. This became a fundamental motivation for the 2008 SER establishing a condition of approval on pursuing a broad range of nuclear safety improvements for PF-4.

While the ventilation system can be overwhelmed by soot without an adequate fire suppression system, fire suppression flow capacity can also be overwhelmed by unconstrained fire growth. Effective fire suppression requires effective fire barriers, ignition source controls, and combustible inventory controls, as previously discussed. The fire suppression upgrade may also strengthen the case for the safety basis assuming a lower-temperature fire, supporting a possible order of magnitude reduction in the calculated consequences. The PF-4 fire suppression system is already supported by an external water supply qualified to the 1996 seismic demand loads; it needs to be confirmed to the updated seismic demand.

By January 2011, LANS will issue conceptual design information for a seismically-qualified safety-class fire suppression system that includes cost, scope, and schedule for upgrades to achieve seismically-qualified fire suppression, factoring in the results of the

seismic SSC studies discussed in Section 5.3, as they are understood at that time (Deliverables 5.3.2 and 5.4.1).

5.4.6 Project Execution Plan

Following NNSA approval of the refined accident analysis and control selection for the post-seismic fire scenario, a project execution plan will be prepared that includes the strategy, cost, scope, schedule, and identified funding sources to complete a set of SSC upgrades that ensure mitigated consequences no longer challenge the DOE 25 rem Evaluation Guideline for seismically-induced events. The funding sources may include expense funding and, if necessary, capital line item funding as part of Phase III of the TA-55 Reinvestment Project (Deliverable 5.4.5).

5.4.7 Conclusion

The site's approach to addressing the post-seismic fire is to recognize that prevention is better than mitigation and that a combination of interdependent controls is required to address this scenario.

When comparing the relative merits of seismically upgrading fire suppression to those for active confinement, the scope of modifications required to seismically qualify PF-4 active confinement ventilation system and support systems appears larger and more complicated at this time than for fire suppression. Active confinement may also be overwhelmed by soot loading released by an unconstrained fire. Fire suppression is also a preventive measure that, along with enhanced fire barriers, ignition source controls, and combustible controls, may keep the fire small, and thereby limit the consequences. The PF-4 fire suppression system is already supported by an external water supply with seismic pedigree.

On the other hand, the ventilation bleed-off subsystem and its supporting power and controls may be sufficient to ensure that the building air remains at a negative differential pressure relative to the outside during and after an earthquake, as the final engineered barrier to radioactive release. Fire suppression flow capacity can also be overwhelmed by unconstrained fire growth; similar to active confinement ventilation, its effectiveness depends on limiting fire conditions by effective fire barriers, and ignition source and combustible controls. Key passive ventilation components are already qualified to the 1996 seismic demand loads.

The prudent course, considering the interdependencies, is to pursue the full suite of nuclear safety improvements outlined above. Overall, these improvements may allow defining, in a technically defensible manner, a lower-temperature, less extensive fire as the bounding credible accident for the post-seismic fire scenario, thereby resulting in improved nuclear safety and lower calculated doses that do not challenge the 25 rem Evaluation Guideline. The design effort and physical improvements have been incorporated in the site's FY-10 Performance Evaluation Plan via Performance Based Incentive (PBI) 7, *High Hazard*

Operations and Emergency Management, and PBI 17, *Improving Nuclear Facility Safety Posture.* Key milestones are captured in the commitments below.

Milestone 5.4.1: Conceptual design for seismically-qualified fire suppression

Deliverable 5.4.1: Reports documenting scope, cost, and schedule for upgrades to achieve a seismically-qualified safety-class fire suppression system (i.e., Performance Category 3 qualified).

Due Date: January 2011

Milestone 5.4.2: Conceptual design for seismically-qualified active confinement ventilation subsystem

Deliverable 5.4.2: Analysis of various options to achieve a seismically-qualified safety-class active confinement ventilation capability (i.e., Performance Category 3 qualified).

Due Date: March 2011

Milestone 5.4.3: Automatic seismic shutdown capability for non-vital laboratory room electrical loads

Deliverable 5.4.3: Installed an automatic seismic shutdown capability for non-vital laboratory room electrical loads that provides an engineered control to reduce laboratory room electrical ignition sources.

Due Date: April 2011

Milestone 5.4.4: Glove-box stand seismic upgrades

Deliverable 5.4.4: Initiate installation of seismic upgrades for the first 10 glove-box stands and complete design for the second phase of glove-box stand seismic upgrades.

Due Date: July 2011

Milestone 5.4.5: Project execution plan for SSC upgrades

Deliverable 5.4.5: Project execution plan that includes strategy, cost, scope, schedule, and identified funding sources to complete a set of SSC upgrades that ensure mitigated consequences no longer challenge the DOE 25 rem Evaluation Guideline for seismically-induced events.

Due Date: 60 days following completion of Deliverable 5.2.3

6.0 ORGANIZATION AND MANAGEMENT

Overall execution of this implementation plan is the responsibility of the Deputy Administrator for Defense Programs, NNSA. An IP Core Team of staff and managers from NNSA Headquarters and the NNSA Los Alamos Site Office has been established to track the status of the deliverables committed to in the plan and coordinate resolution of emergent issues with the DNFSB and DNFSB staff. The IP Core Team will be led by the Assistant Deputy Administrator for Nuclear Safety and Operations, Office of Defense Programs, NNSA.

6.1 Roles and Responsibilities

The 2009-2 Implementation Plan Core Team has the following responsibilities:

- Coordinate overall implementation of the Department's 2009-2 Implementation Plan;
- Monitor plan milestones and provide assistance and feedback to keep plan milestones on schedule;
- Review all 2009-2 Implementation Plan deliverables for completeness and consistency, and provide input and recommendations to the IP Core Team lead; and
- Keep DOE's executive leadership informed of overall plan performance and any issues that need senior management attention and direction.

6.2 Change Control

Complex, long-range plans require sufficient flexibility to accommodate changes in commitments, actions, or completion dates that may be necessary due to additional information, improvements, or changes in baseline assumptions. The Department's policy is to: (1) provide prior, written notification to the DNFSB on the status of any implementation plan commitment that will not be completed by the planned milestone date; (2) have the NNSA Deputy Administrator for Defense Programs approve all revisions to the scope and schedule of plan commitments; and **(**3**)** clearly identify and describe the revisions and basis for the revisions. Fundamental changes to the plan's strategy, scope, or schedule will be provided to the DNFSB through formal revision and reissuance of the implementation plan. Other changes to the scope or schedule of planned commitments will be formally submitted in appropriate correspondence approved by the NNSA Deputy Administrator for Defense Programs, along with the basis for the changes and appropriate corrective actions.

6.3 Reporting

To ensure the DNFSB remains informed of the status of plan implementation, the Department plans to provide progress reports to the DNFSB and DNFSB staff approximately every three months.

Commitment 6.3.1: The Department will provide briefings to the DNFSB and DNFSB staff, including updates on the status of completing actions identified in in this IP.

Lead Responsibility: Assistant Deputy Administrator for Nuclear Safety and Operations, Office of Defense Programs, NNSA

Deliverable 6.3.1: Status briefing on the completion of implementation plan milestones and deliverables

Due Date: October 2010 and approximately every three months thereafter until the final milestone is completed

Following completion of the final milestone, the Department plans to provide progress reports to the DNFSB and DNFSB staff approximately every year until all necessary modifications and upgrades to safety class SSCs are completed and fully implemented.

Table - Summary of Deliverables

No.	Milestones/ Deliverables	Deliverable	Anticipated Delivery Date
5.1	Near-term actions to reduce the consequences of a seismically-induced fire	Documented completion of near-term actions from Section 4 of this implementation plan.	December 2010
5.2.1	Refined unmitigated accident analysis for all seismically-induced events	Summary of unmitigated accident analysis for seismically-induced events, including scenario description, accident progression, assumptions, and unmitigated dose consequences	November 2010
5.2.2	Refined accident analysis and control selection in the safety basis update	LANS submittal of an updated safety basis, including refined accident analysis and control selection for seismically-induced events that demonstrates that mitigated consequences are well below the Evaluation Guideline or establishes an executable strategy to achieve mitigated consequences that no longer challenge the Evaluation Guideline. The technical basis for the safety basis update will include the decision logic and criteria for evaluating and selecting safety structures, systems, and components.	May 2011
5.2.3	NNSA approval of the refined accident analysis and control selection	NNSA review and approval of the refined accident analysis and control selection for the post-seismic fire scenario that either demonstrates that mitigated consequences are well below the Evaluation Guideline or establishes an executable strategy to achieve mitigated consequences that no longer challenge the Evaluation Guideline.	60 days following completion of Deliverable 5.2.2
5.3.1	PF-4 SAFER Scope	This deliverable includes the following scope: (1) PF-4 Structural Analysis and Acceptance Criteria; (2) PF-4 Systems and Components, Analysis and Acceptance Criteria for fire suppression	September 2010

		and active confinement ventilation; (3) Table of seismic analysis calculations with schedule; and (4) Seismic Equipment List providing systems and components included in the systems and components evaluations.	
5.3.2	Seismic structure, systems, and component reports	Final reports documenting seismic performance level and whether safety class SSCs meet the target performance goals in DOE-STD-1020. For those safety class SSCs that do not achieve desired performance, sufficient information will be included to allow retrofit and cost studies.	May 2011
5.4.1	Conceptual design for seismically-qualified fire suppression	Reports documenting scope, cost, and schedule for upgrades to achieve seismically-qualified safety-class fire suppression system (i.e., Performance Category 3 qualified).	January 2011
5.4.2	Conceptual design for seismically-qualified active confinement ventilation subsystem	Analysis of various options to achieve a seismically-qualified safety-class active confinement ventilation capability (i.e., Performance Category 3 qualified).	March 2011
5.4.3	Automatic seismic shutdown capability for non-vital laboratory room electrical loads	Installed an automatic seismic shutdown capability for non-vital laboratory room electrical loads that provides an engineered control to reduce laboratory room electrical ignition sources.	April 2011
5.4.4	Glove-box stand seismic upgrades	Initiate installation of seismic upgrades for the first 10 glove-box stands and complete design for the second phase of glove-box stand seismic upgrades.	July 2011
5.4.5	Project execution plan for SSC upgrades	Project Execution Plan that includes strategy, cost, scope, schedule, and identified funding sources to complete a set of upgrades that ensure mitigated consequences no longer challenge the DOE 25 rem Evaluation Guideline for seismically-induced events.	60 days following completion of Deliverable 5.2.3
6.3.1	DNFSB briefings	Briefings - Quarterly	Starting October 2010