Department of Energy
National Nuclear Security Administration
Washington DC 20585

NOV 0 5 2012

OFFICE OF THE ADMINISTRATOR

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

Dear Mr. Chairman:

The National Nuclear Security Administration (NNSA) has reviewed your letter of June 18, 2012, on the Los Alamos National Laboratory Plutonium Facility (PF-4) Safety Basis. NNSA shares the Board's perspective on the importance of this facility, ensuring it has a quality safety basis, and ensuring continuous improvement in our nuclear safety posture.

Enclosure 1 provides the specific information requested by the Board and Enclosure 2 provides an analysis of the technical concerns raised by your staff. The PF-4 Safety Basis has undergone two partial revisions since the version reviewed by the Board was issued. Los Alamos National Security, LLC (LANS) submitted an annual update on September 28, 2012. The NNSA Los Alamos Site Office and LANS are focused on continuously improving the PF-4 Safety Basis and the facility's nuclear safety posture as part of the annual update process required by the Nuclear Safety Management Rule, 10 CFR 830.

NNSA will schedule a briefing to the Board on the conclusions of our review.

If you have any questions concerning this letter, please contact Mr. James McConnell, Deputy Associate Administrator for Infrastructure and Operations, at (202) 586-4379.

Sincerely,

Thomas P. D'Agostino
Administrator

Enclosures

cc: M. Campagnone, HS-1.1
M. Lempke, NA-00
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1. Executive Summary

In a June 18, 2012, letter to the National Nuclear Security Administration (NNSA), the Defense Nuclear Facilities Safety Board (DNFSB or Board) provided its review of the Plutonium Facility (PF-4) Safety Basis approved in October 2011 (Revision 1.0). The letter concludes that, for one accident (the post-seismic fire), the mitigated dose consequences to the public exceed 100 rem total effective dose equivalent, which would require additional safety controls for the facility. The DNFSB provided a staff issue report that identified specific concerns.

The letter observed that contractor development and submission of high quality Documented Safety Analyses (DSAs) in accordance with the Nuclear Safety Management Rule (10 CFR 830) and thorough and critical review by NNSA are fundamental elements for ensuring safe operations at defense nuclear facilities. The DNFSB requested a briefing and report, which contain the following:

1. NNSA plans for providing a sound and technically justifiable safety basis that includes correction of the non-conservative deficiencies identified in the DNFSB staff's issue report;

2. Necessary actions to ensure that quality assurance requirements are adequately implemented at Los Alamos National Laboratory (LANL) for safety basis development; and

3. NNSA actions to ensure safety basis review and approval processes are performed with sufficient rigor to prevent technically deficient safety bases from being approved.

These specific requests are addressed below in Sections 2-4, and a technical evaluation by Los Alamos National Security, LLC (LANS) is provided in Enclosure 2. The PF-4 DSA has been revised twice since the version reviewed by the DNFSB and its staff; the current approved version is Revision 1.2, and the next revision was recently submitted to NNSA. Section 5 below summarizes the post-seismic fire accident scenario.

Overall, NNSA agrees with the DNFSB on the importance of high quality DSAs and thorough and critical federal technical reviews to ensure safe operations. NNSA and LANS are focused on continuous improvement in these areas, with the objective of safety and operational excellence. An example is the two revisions made within the last six months to the PF-4 DSA to make necessary improvements. NNSA acknowledges that the PF-4 Safety Basis still needs further improvement and efforts in that direction are described in the responses below. LANS recently submitted a major update to NNSA on September 28, 2012.

2. Plans to Provide A Sound, Technically Justifiable Safety Basis

The complex nature and sheer magnitude of the PF-4 safety basis indicate some of the challenges with reviewing and approving the document, and illustrate areas where more effective management can improve its quality. The document includes thousands of pages; the pace of

change from facility modifications and analytical upgrades can overwhelm the review and approval system and the capacity of the safety analysts if changes are allowed to accrue for longer than a year. Consequently, the NNSA Los Alamos Site Office (LASO) is working with the contractor to ensure that LANS update processes anticipate the next annual update far enough in advance to ensure that changes are fed into the system without overloading the capacities of the analysts, avoiding a rush to meet the update schedule.

NNSA acknowledges that the PF-4 Safety Basis needs further improvement; it is the most complex of the site's nine nuclear facility safety bases with hundreds of hazard analyses and a couple dozen detailed accident analyses, including two that involve seismic events. The need for frequent updates exacerbates the capacity problem discussed above but also drives the need to involve a large number of diverse subject matter experts in the review process over a relatively short period of time. Collocating the comments and input from the diverse community on complex analyses drives a need for more effective technical coordination processes during updates. To address this need, LANS is borrowing some of the techniques instituted in DOE-STD-1189 for ensuring a coordinated approach to incorporation of safety into design, such as the development of safety strategy documents that define the scope. The safety basis update team will also meet periodically, much as does a Safety Design Integration Team, to discuss changes to accident scenarios, brainstorm considerations that must be addressed, and de-conflict schedules for performing the analysis.

Fundamentally to address this issue, NNSA's plan is to direct and incentivize LANS to continuously improve LANL nuclear facility safety bases, including PF-4's, as part of the annual DSA update process required by 10 CFR 830. NNSA expects LANS to evaluate new information and emergent issues and take necessary actions to ensure public and worker safety in accordance with the 10 CFR 830 Potential Inadequacy in the Safety Analysis (PISA) process. LANS understands this and has used that process to assess the concerns identified in the DNFSB staff report. Some issues may not rise to the level of a PISA, but, even when they do not, they provide useful information concerning a need for greater clarity in the analysis and documentation that will be pursued as part of the annual update process, as indicated in Enclosure 2.

The safety basis approved in December 2008 (Revision 0) was the first update since 1996 and constituted a significant step forward that led to a broad range of nuclear safety initiatives. Considerable effort since then has focused on reducing the actual risk at PF-4 through initiatives such as repackaging plutonium in more robust containers; disposing of plutonium that is no longer required; reducing combustible inventory by tons; eliminating potential ignition sources; improving fire barriers; and improving the fire protection system.

While the 2008 safety basis strengthened PF-4's defenses for more than two dozen postulated accidents, it did not fully address some postulated aspects of a large magnitude earthquake that could cause a fire, leaving that for a future DSA update. The evaluation basis earthquake is one

that is estimated to occur once in several thousand years. This post-seismic fire scenario was the focus of the DNFSB's Recommendation 2009-2, which was issued in October 2009. DOE accepted Recommendation 2009-2 and all the actions of the implementation plan for that recommendation have been completed. Nevertheless, there are additional actions that NNSA has committed to and other actions NNSA is considering to further lower the risk associated with a large earthquake at PF-4.

In October 2011, March 2012, and May 2012, NNSA approved further changes to the PF-4 DSA, driving continuous improvement (2011 DSA Revisions 1.0, 1.1, and 1.2). The NNSA Safety Evaluation Report (SER) that approves each revision has itself been revised eight times since its initial issue in December 2008. The current SER directs a number of further improvements that are expected to be made in safety basis revisions in September 2012 and over the next two years. These include but are not limited to the following:

- Improved process descriptions to improve hazard identification;
- Improved safety system descriptions, including adding relevant information to improve system operability determinations;
- Reevaluated process hazard analyses, including ensuring a comprehensive accident spectrum has been evaluated, the hazards identified, and appropriate safety controls selected;
- Reevaluated selection of bounding, representative, and unique accidents to ensure appropriate accident scenarios are selected for detailed analysis;
- Improved safety control selection process to ensure that preferences for the hierarchy of controls described in DOE-STD-3009, Change Notice No. 3, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, have been applied and appropriate safety controls are traceable to the hazard analysis;
- Closure of comments in the fire hazard analysis; and
- A periodically updated project management mechanism to track status and ensure priority for planned nuclear safety facility improvements.

NNSA believes this constitutes a comprehensive approach to improving the PF-4 DSA and the facility's nuclear safety posture.

3. Ensuring Quality in Safety Basis Development

NNSA acknowledges that the quality of LANL nuclear facility safety bases needs to be improved. NNSA and LANS are working to ensure that each nuclear facility safety basis update for each LANL nuclear facility is an improvement over the previous version. This reflects a

maturing process. As discussed above, NNSA will direct and incentivize LANS to continuously improve nuclear facility safety bases, including PF-4's, as part of the annual DSA update process required by 10 CFR 830. Specifically, NNSA's Fiscal Year 2013 Strategic Performance Plan for LANL has a clear expectation that LANS will improve nuclear and high hazard operations safety performance in areas including, but not limited to, safety basis implementation and formality of operations. In October 2012, NNSA directed LANS to submit for concurrence a resource-loaded safety basis improvement plan that focuses on (1) having safety bases that include sufficient controls to ensure nuclear safety and that can be readily implemented in the facilities, and (2) sustainably implementing those controls and verifying their implementation.

Regarding responses to specific DNFSB staff report issues with PF-4 DSA input documents, please see the "Review of Input Documents" section of Enclosure 2.

4. Ensuring Rigorous Federal Review of Safety Bases

NNSA continues to strive to improve its safety basis review process. The NNSA review of the PF-4 DSA, Revision 1.0, followed the applicable Department of Energy (DOE) standard (DOE-STD-1104-2009, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*) and LASO procedure but there is room for improvement. NNSA is pursuing enhanced training, such as the safety basis academy courses, to strengthen the technical expertise of future safety basis review teams. Also, as described above under Section 2, LASO will work with LANS to develop safety strategy documents that define the scope of annual DSA updates that are then approved by LASO. The safety basis update team will also meet periodically to discuss topics such as changes to accident scenarios, considerations that must be addressed, and scheduling and resource conflicts that must be adjudicated for updating the DSA.

All changes to Revision 1.0 of the 2011 DSA and TSRs were reviewed. The Safety Basis Review Team (SBRT) focused on the adequacy of approval attributes described in DOE-STD-1104 for areas where changes were made. These include:

- Base information;
- Planned improvements;
- Hazard and accident analyses;
- Safety Structures, Systems, and Components (SSC);
- Defense-in-depth and worker protection controls;
- Specific Administrative Controls;
- Derivation of TSRs; and
- Safety management program characteristics and attributes.

The primary focus of the federal review was the revised seismic evaluation basis accident. In the process, the team reviewed several submitted, but unapproved, DSA versions dating back to 2009, and resolution of prior NNSA comments. New comments were generated and provided to

LANS, comment resolution meetings were held, and comments were adjudicated. LANS then made changes to the DSA and resubmitted it for approval. The SBRT members verified that changes made in the final version adequately incorporated prior comments. This process followed Section 1.4 of DOE-STD-1104. Following final review of comment resolution, the SER was revised to document the major changes to the DSA and closure of NNSA comments.

The DSA, Revision 1.0, was the result of an extensive effort mainly focused on re-evaluation of the post-seismic fire accident, and resolution of prior NNSA comments dating back nearly three years. The revised post-seismic fire accident analysis included re-evaluation of the fire characteristics, the number of fires, and the resulting effects on the leak path factor. Other changes to this accident included material-at-risk involved in the accident, refinement of airborne release fraction and respirable fraction values, atmospheric dispersion analysis, breathing rate and certain absorption rates, and ultimately the dose consequence value. All of these factors were extensively reviewed; numerous comments were provided to the contactor and subsequently addressed.

Following the review of the base information and the accident analysis, the control selection was reviewed for adequacy to protect the public, the workers, and the environment. Every option for a safety class control was examined. For the post-seismic fire scenario, additional safety-class controls were selected including fire-rated containers, fire-rated safes, and seismic switches, in addition to a significantly refined material-at-risk control. Descriptions of selected controls were also reviewed which included reviewing the safety function, functional requirements, performance criteria and evaluation of the control.

NNSA will continue to strive to improve the implementation of the federal review process that is consistent with applicable Department of Energy requirements, including the leveraging of NNSA safety basis resources (e.g., support from the NNSA Albuquerque Complex). Also, as part of the new information and the safety basis update processes, the site will review DNFSB correspondence to ensure that new information from all sources is considered for their nuclear safety implications.

5. Conservatisms in the Post-Seismic Fire Accident Scenario

As the DNFSB pointed out, there is a need to improve the clarity and accuracy of the DSA and to incorporate new information on PF-4's seismic performance. Using the available information, the 2011 approved DSA conservatively demonstrated that the calculated dose to the maximally exposed off-site individual is near the DOE Evaluation Guideline (25 rem). In addition, planned improvements to the facility listed in the DSA are expected to further reduce the calculated dose; these include seismic upgrades to fire suppression and glove-box stands scheduled for the next two years, as well as longer-term upgrades. These efforts are discussed in the PF-4 Seismic Project Execution Plan, which is scheduled to be revised later in 2012.

New information became available in September 2012 that indicates a rare large earthquake may induce additional structural failure modes; this new information has been evaluated in accordance with the PISA process required by 10 CFR 830. NNSA is conducting additional analysis to determine what additional safety controls may be needed, as described in the enclosures to the letter from the Deputy Secretary to the DNFSB Chairman, dated July 19, 2012.

NNSA considers that the post-seismic fire accident analysis in the approved DSA is reasonably conservative for the following reasons:

- PF-4 has extensive safety controls that reduce the probability and consequences for this accident scenario. These include, but are not limited to, passive confinement; robust plutonium storage systems; reduced material-at-risk limits; and seismic switches that would isolate non-vital laboratory electrical loads, thereby eliminating key fire ignition sources. PF-4 has also dramatically reduced combustibles since 2009, and implemented stringent combustible controls, ignition source controls, fire barrier upgrades and maintenance, and other relevant improvements.

- Previous seismic evaluations indicate laboratory rooms maintain the configuration assumed in the DSA following a major earthquake. The PF-4 structure is being reevaluated considering recent seismic upgrades. Additional structural issues have been identified, as discussed above; the site is following the 10 CFR 830 PISA process.

  An assumption that the interior walls between the laboratories and the walls between the laboratories and the corridor survive the seismic event has been revaluated by LANS. Results show that if the interior laboratory walls of PF-4 failed, wall failure after a seismic event would actually cause a lower temperature fire than with the walls intact. Thus, assuming that the interior laboratory walls remain standing is conservative and is consistent with these walls meeting Performance Category 3 (PC-3) seismic criteria. LANS calculations show that the walls separating the laboratory rooms from the corridors also remain standing after the PC-3 seismic event. Appropriate new references that form this technical basis in regards to the laboratory walls have been added to the newly submitted 2012 DSA.

- The DSA makes conservative assumptions on internal and external door openings, fire heat release rates, and the assumed motive force that would propel plutonium out of the building main floor following an earthquake. The motive force has two key components:
  - Fire in laboratory rooms cause air to flow out of laboratory doors into the main corridors; these doors are assumed to be open for the duration of the event. That air flow entrains airborne plutonium and increases pressure in the corridors. The increased pressure causes plutonium contaminated air to flow out of the building exits at the ends of the two main corridors; and

- The main floor exit doors (five doors per corridor) are all assumed to be open for the first five minutes of the accident. The DSA assumes a 2 m/s wind flows down the corridor, further propelling plutonium contaminated air from PF-4; the wind speed is based on a computational fluid dynamics analysis that considered 48 combinations of outside wind speeds and directions and ignored adjacent buildings. In particular, the effectiveness of the adjacent building (PF-3) at blocking this air flow is ignored.

- In 2005, the American Society of Civil Engineers (ASCE) and the National Fire Protection Association (NFPA) technical council on lifeline earthquake engineering published a monograph on fires following earthquakes. The data indicate that most post-seismic fires are initiated by natural gas leaks or electrical faults in buildings constructed of wood. PF-4 is a concrete structure without natural gas, with stringent ignition and combustible control programs, and with a new automatic seismic shutoff system to eliminate critical ignition sources. The DSA assumes several fires are ignited following an earthquake and that these occur in the worst possible locations in the building. The 2012 proposed DSA has reduced reliance on this analysis by just assuming a limited but still conservative number and locations for fires.

- LANS evaluated numerous combinations of laboratory room fires to establish the worst possible locations, which are the locations that would result in the largest release of airborne respirable plutonium from the building. The DSA assumes two fires located in laboratory rooms close to a building exit and assumes an artificially increased plutonium inventory in these two rooms. These effects lead to a conservative predicted release (i.e., higher leak path factor).

- While the bounding leak path factor is derived by considering fire in only a few rooms, it is applied to all material-at-risk in all the rooms on the main floor for the fire portion of the source term. The analysis also assumes that all glove-boxes topple and spill plutonium.

- The DSA assumes bounding airborne release fractions and respirable fractions considering the DOE handbook reference for these values. The specific concerns identified by the DNFSB staff in this area are addressed by LANS in Enclosure 2. For the seismic spill event, the respirable fraction (RF) value of 0.3 was selected based on the assumption that all the gloveboxes, enclosures, or material containers topple from a height less than 3 meters. For the post-seismic fire event, the RF of 0.1 selected for the thermal stress is supported by the fact that agglomeration is technically defensible and this value is 10 times the bounding value as provided by DOE-HDBK-3010, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities.* These changes have been made to Revision 1.2 of the 2011 DSA.

Additional planned improvements include the following: (1) NNSA intends to seismically upgrade stands for glove-boxes that contain molten plutonium operations during the next few years, further reducing the potential for release; and (2) LANS is also pursuing fire testing and safety-class designation for plutonium-238 ball-mill containers.

In summary, while the DSA provides a technical basis and insight, it is the safety control selection and implementation that ensure adequate levels of protection for the workers, the public, and the environment. NNSA judges that, taken as a whole, the DSA provides a reasonably conservative basis for establishing the adequacy of the selected controls, and an acceptable basis for concluding that the workers, public and the environment are adequately protected. At the same time, NNSA accepts the DNFSB's conclusion that the DSA needs to be improved. Both NNSA and LANS are committed to continuous improvement, including with the latest revision to the DSA that is currently under review.

6. Conclusion

NNSA agrees with the DNFSB on the importance of high quality DSAs and thorough and critical federal technical reviews to ensure safe operations. NNSA and LANS are focused on continuous improvement in these areas, with the objective of safety and operational excellence. The specific technical concerns identified by the DNFSB are being addressed as part of the PISA and DSA annual update processes. While the PF-4 DSA, Revision 1.0, has a calculated dose to the maximally exposed off-site individual on the order of the 25 rem evaluation guideline, NNSA and LANS continue to develop and implement additional safety controls that will further reduce post-seismic fire accident consequences and improve PF-4's nuclear safety posture.

UNITED STATES GOVERNMENT **DEPARTMENT OF ENERGY**

memorandum

National Nuclear Security Administration
Los Alamos Site Office
Los Alamos, New Mexico 87544

DATE: AUG 24 2012
REPLY TO
ATTN OF: Kevin W. Smith
SUBJECT: Plutonium Facility (PF-4) – Evaluation of Safety Basis Concerns

TO: Donald L. Cook, Deputy Administrator for Defense Programs, National Nuclear Security Administration, NA-10, HQ/FORS

THRU: James J. McConnell, Assistant Deputy Administrator for Nuclear Safety, Nuclear Operations and Governance Reform, National Nuclear Security Administration, NA-17, HQ/FORS

References:
1. Defense Nuclear Facilities Safety Board Letter (DNFSB), to Thomas P. D'Agostino, NA-1, HQ/FORS, from Peter S. Winokur, Chairman, DNFSB, dated June 18, 2012 (LASO COR-SO-6.18.2012-446808)
2. 10 CFR 830, *Nuclear Safety Management*
3. LANS Letter AD-NHHO:12-213, to C. H. Keilers, AMSO, LASO, from Charles E. Anderson, ADNHHO, LANS, Subject: *Plutonium Facility (PF -4) -Response to Request for Action Related to Safety Basis Issues Identified by the Defense Nuclear Facility Safety Board*, dated August 22, 2012 (LASO COR-SO-8.23.2012-460739)

Reference (1) provided a staff report of the Los Alamos National Laboratory Plutonium Facility (PF-4) Documented Safety Analysis (DSA) that was approved in October 2011. The DSA has undergone two partial revisions since then, and an annual update is scheduled to be submitted by September 30, 2012. The Los Alamos Site Office (LASO) and Los Alamos National Security, LLC (LANS) are focused on continuously improving the PF-4 DSA and the facility's nuclear safety posture as part of the annual update process required by Reference (2).

Attached [Reference (3)] is a LANS technical evaluation of specific concerns raised in the staff report attached to Reference (1). LASO agrees with the LANS technical evaluation and will work with your staff on developing the Department of Energy's response to Reference (1).

If there are questions, you may contact Kevin W. Smith at (505) 667-5105 or C.H. Keilers at (505) 606-1944.

Kevin W. Smith
Manager

Attachment

cc w/attachment:
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Date: August 22, 2012
Refer To: AD-NHHO:12-213

Mr. C. H. Keilers
Assistant Manager Safety Operations
Los Alamos Site Office
Los Alamos, NM 87544

Subject: Plutonium Facility (PF-4) – Response to Request for Action Related to Safety Basis Issues Identified by the Defense Nuclear Facility Safety Board

Reference: 1) SO:26CK-446807, *Plutonium Facility (PF-4) - Request for Action on Safety Basis Issues Identified by the Defense Nuclear Facilities Safety Board,* Memorandum from C. H. Keilers, AMSO, LASO to C. E. Anderson, ADNHHO, LANS, LLC, June 18, 2012.
2) *Documented Safety Analysis and Post-Seismic Accident Consequences, Plutonium Facility, Los Alamos National Laboratory*, Defense Nuclear Facilities Safety Board Staff Issue Report, May 8, 2012, as transmitted from P. S. Winokur to T. P. D' Agostino, June 18, 2012.

Dear Mr. Keilers:

Pursuant to your request dated June 18, 2012 (Ref. 1), this letter provides the Los Alamos National Security (LANS), LLC recommended responses along with detailed technical justification to fully adjudicate the Safety Basis Issues identified by the Defense Nuclear Facility Safety Board (DNFSB) (Ref 2.).

As reflected in the attachment, LANS considers that the overall analysis provided in the 2011 Technical Area (TA55) Documented Safety Analysis (DSA) is both conservative and appropriate in providing reasonable assurance of adequate protection of workers, the public, and the environment from adverse consequences, taking into account the work to be performed and the associated hazards. However, in recognition of two specific issues related to the application of the Leak Path Factor and the probability of a post seismic event basement fire, LANS has entered its New Information process and declared Potential Inadequate Safety Analyses (PISAs), based on the application of the safety culture principle of conservative decision-making.

As described in the approved Safety Basis Strategy, the revised seismic accident analysis in the 2011 TA55 DSA is only the first step in the planned and continual strengthening of the safety posture for TA55. Current fully functional Safety Class (SC) controls in the 2011 TA55 DSA include: seismic switches that remove power from gloveboxes, reduced MAR limits, storage containers with low damage ratios, and passive confinement.

Planned upgrades and operational improvements delineated in the 2011 TA55 DSA and identified as SC controls include: active confinement ventilation, fire suppression, and glovebox stands to meet more stringent seismic qualification.

The 2011 TA55 DSA prepared by LANS and approved by the Los Alamos Site Office (LASO) documented the conservatisms in the analysis along with the rationale and justification for each of the assumptions identified. The detailed documentation of the individual calculations not only meets DOE STD 3009, but also goes beyond the minimum level of detail required. For example, both the fire model and the subsequent analysis of the leak path factor were constructed with multiple, stacked layers of conservatism.

The technical response and justification to each of the issues raised by the DNFSB is provided in an attachment to this letter.

Please contact James Tingey at phone 667-4229 if you have questions or need additional information regarding this submittal.

Sincerely,

Charles E. Anderson
Associate Director
Nuclear and High Hazard Operations

CEA/pse

Attachment: 1. Technical Justification in Response to DNFSB Issues on the 2011 TA55 DSA

Cys:
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Technical Justification in Response to DNFSB Issues on the 2011 TA55 DSA

The following information is provided as a response to the May 8, 2012 Defense Nuclear Facility Safety Board (DNFSB) Staff Issue Report memorandum entitled, *Documented Safety Analysis and Post-Seismic Accident Consequences, Plutonium Facility, Los Alamos National Laboratory.*

Conservatisms in the Plutonium Facility Seismic Analysis

The 2011 TA55 Documented Safety Analysis (DSA) prepared by Los Alamos National Security, LLC (LANS) and approved by the National Nuclear Security Administration (NNSA) Los Alamos Site Office (LASO) documents numerous conservative assumptions; the rationale and justification for each of the assumptions; and a detailed discussion of individual calculations that not only meets the expectations of DOE STD 3009 but also goes beyond the minimum level of detail required. In summary, both the fire model and the subsequent analysis of the leak path factor (LPF) were conservatively constructed and the results are appropriately bounding.

The following conservative assumptions are discussed in the Plutonium Facility DSA (partial list):

- **Fire: Based on the statistical analysis of fires following earthquakes, t**he large first floor facility-wide fire as modeled in the 2008 DSA was determined to be not likely. The smaller four-room, post seismic fire model used to develop the LPF (one random fire and three deterministically based fires where molten metal operations exist) is conservative. Note that the nomenclature for these fires, sometimes referred to as a probabilistic fire and three deterministic fires, describes the approach taken to identify the nature of fire initiated by the seismic Design Basis Accident (DBA). That is, they describe how the extent and severity of credible initiated fires were determined for the purposes of detailing the DBA. The functions and performance criteria for safety controls for this accident are assigned deterministically, consistent with DOE STD 3009 methodology.
- **MAR**: All (100%) of the first floor MAR was subjected to both spill and thermal impact through the calculation of source term based upon application of both appropriate mechanical stress Airborne Release Fraction×Respirable Fraction (ARF×RF) and appropriate thermal stress ARF×RF values. Since the fire and seismic induced spill were calculated separately, the spill analysis acted upon all the MAR and the fire analysis also acted on all the MAR; i.e., though the LPF for the fire was developed based upon multiple room fires rather than a facility wide fire, the final consequence analysis conservatively applied thermal stress to 100% of the first floor MAR, as opposed to just the rooms with fires. A less-than-floor-wide-fire was only considered for the purpose of development of the LPF. While unrealistic, this methodology produces extremely conservative results to the downwind dose receptor.
- **DR**: No reduction in DR was taken (i.e., 100% of the MAR escapes containers) despite some robust containers that demonstrate via challenging engineering tests, leak-tightness under accident conditions.
- **ARF and RF**: Bounding ARFs and RFs were used and apportioned by material forms to conservatively represent upset conditions from both spill and thermal stress.
- **LPF**: LPF values for the fire portion of the analysis ranged from 1.5% to 17.6%. A conservative value of 18% was used in the fire analysis.
- **LPF**: When the 18% LPF was calculated, 60% of MAR was conservatively placed in rooms containing fires near exit doors. This overestimated the amount of MAR in rooms near exit doors and overestimated the amount of MAR escaping to the environment.
- **LPF**: The LPF calculation assumes all airlock and security doors are open for the first 300 seconds; doors from laboratory rooms to the corridor are open throughout the analysis timeline. Further, the analysis assumes the absence of the adjacent PF-3 building which would restrict airflow through PF-4 and reduce the amount of MAR escaping to the environment.
- **CFAST**: The heat release rate used in fire modeling was overestimated by a factor of 1.5 (150%)

- χ/Q: The dispersion parameter, χ/Q, was calculated for release heights ranging from a ground release (z = 0) to the height of the PF-4 stack (z = 16 meters). The maximum value for χ/Q corresponding to a release height of z = 14 meters was selected to calculate downwind receptor dose. While unrealistic, using the maximum value for χ/Q that occurs at 14-meters overestimates the dose to downwind receptors. In the case where the environmental release is dominated by the open facility doors, as analyzed following a seismic event, using the maximum value for χ/Q at 14-meters would overestimate the dose to downwind receptors by 23% (z = 0 meters height) for a ground-level release.

Likelihood of New or Additional Safety Class Controls

LANS has evaluated in detail the DNFSB issues and concludes that even if the estimated MEOI dose were increased, no new or additional Safety Class (SC) controls would be identified or recommended. As described in the approved Safety Basis Strategy, the revised seismic accident analysis in the 2011 TA55 DSA is only the first step in the planned and continual strengthening of the safety posture for TA55. Current fully functional SC controls in the 2011 TA55 DSA include: seismic switches that remove power from gloveboxes, reduced MAR limits, storage containers with low damage ratios, and passive confinement. Planned upgrades and operational improvements identified in the 2011 TA55 DSA and identified as SC controls include: active confinement ventilation, fire suppression, and glovebox stands to meet more stringent seismic qualification. These controls are in addition to the nearly 50% reduction in MAR from the 2008 DSA to the current 2011 DSA.

Discussion of Individual DNFSB Concerns

In their May 8, 2012, memorandum the DNFSB "reviewed the four accident analysis parameters that serve as the underpinning of the 2011 DSA: the quantity of material at risk, airborne release fractions, respirable fractions, and LPF" and noted a number of issues that the DNFSB considers challenging the technical basis for accident analysis parameters. The following paragraphs identify the DNFSB concern followed by a LANS technical response that addresses each Board concern. LANS paraphrased DNFSB concerns in bold font in order to identify the issue being addressed, but for the sake of brevity did not reiterate the observations in their entirety. The revision of the DSA considered by the DNFSB was Revision 1.0, however, the DSA has been subsequently revised two times (Revision 1.1, approved April 3, 2012 and Revision 1.2, approved May 21, 2012) since Revision 1.0 with the result that some of the concerns discussed below have been addressed in these more recent revisions.

Leak Path Factor: The 2011 DSA derived a new lower Leak Path Factor (LPF) by following a process of first analyzing historical data related to fires reported following earthquakes to establish a probabilistic method for concluding that seismically induced fires would be limited to a number of individual laboratory rooms (a single random fire room and three rooms in which, due to the nature of operations within those rooms fire is deterministically assumed to occur). Subsequently CFAST software was used to model fires and develop transient thermal and transport profiles as inputs to MELCOR calculations to calculate the amount of material transported from the building and hence to estimate a conservative LPF. Several of the DNFSB observations relate to aspects of this multi-step process to determine the LPF values utilized in the LANL 2011 TA-55 DSA.

It is observed by the DNFSB that "consequence calculations for the fire component of the release use the 18 percent LPF calculated by the MELCOR model. However, consequence calculations for the spill component of the release use an LPF of only 5 percent. Given that the 18 percent LPF value was calculated in MELCOR for an integrated scenario that included both spill and fire releases, it is not technically justifiable to use a separate, lower LPF value for the spill contribution."

As observed, the 2011 DSA used two different conservative LPF values; a LPF for the spill portion of the analysis and a different LPF for the fire consequence calculations. A conservative value of 5% was used for the LPF for the spill portion of the analysis; the same value used in the 2008 DSA. A 5% LPF is reasonably conservative because (1) all of the MAR was acted upon by both the spill and fire portion of the analysis thereby overestimating the dose to a downwind receptor from the fire (thermal stress ARF×RF was applied to all MAR in the first floor, regardless of whether or not the MAR was in a room with a fire); (2) an LPF of 5% is within the range of LPFs generated for the integrated fire/spill portion of the analysis; and (3) several of the sensitivity cases performed for the integrated fire analysis produced a LPF of 5% or less. As the seismic analysis for the 2011 DSA was developed to primarily concentrate on the fire portion of the event, it was not intended to apply a single LPF value to address both spill and thermal stress impacts to MAR. The range of calculated LPFs for the integrated spill and fire scenario ranged from 1.5% to 17.6% so the use of 5% for the spill portion of the analysis was not inconsistent with analysis results. The use of the 5% LPF for the spill allowed direct comparison with that approved 2008 accident scenario and was not re-calculated; also a value that exceeded the calculated range was conservatively chosen to apply to the fire portion of the event. Further, the unmitigated analysis (LPF of unity) met the DOE-STD-3009 purpose of unmitigated analysis: identifying the need for Safety Class controls.

The 2011 MELCOR calculations determined a range of LPF values depending on MAR location, weighting factors and fire rooms. The chosen value of 18% was greater than the highest calculated value using extremely conservative assumptions. With the 18% LPF for the fire portion and the 5% for the spill portion, the calculated mitigated consequences (with only passive confinement) were near the evaluation guideline. However, the use of other LPF values from within the calculated range would have been appropriate. For example, using the MELCOR LPF of 8.6% for a four fire room scenario with historical MAR distribution and no weighting factor for both the spill and fire portions would have yielded a dose that was not significantly different. The key point is that the net result would have been no change in the SC controls selected.

However, applying the 18% LPF to the spill portion of the analyzed accident, and adding this to the fire portion (already analyzed at 18% LPF) would result in an increase to the analyzed and approved offsite dose. Therefore, this information was evaluated through the LANL New Information process and a Potential Inadequacy of the Safety Analysis (PISA) was declared.

Laboratory Walls: **The DNFSB memo observes that the CFAST and MELCOR models assume that the laboratory walls remain intact after an earthquake and deems this to be implicit crediting of laboratory walls and is concerned that "Inappropriately relying on laboratory walls to perform functions that they are not credited or qualified to perform is a non-conservative assumption that potentially underestimates the LPF and overall offsite dose consequence."** The previous version of the DSA included reference to an analysis that the laboratory walls would remain intact after an earthquake. The interior laboratory walls were recently re-analyzed and shown to remain intact following the new earthquake loads. The walls between the corridor and the laboratory were qualitatively evaluated and affirmed to remain intact under the design seismic loads by the structural engineer who performed the interior wall calculation. The calculation is being revised to reflect the analysis of the corridor walls. It is a DOE-STD-3009 expectation that the mention of an SSC's presence in an accident scenario does not necessarily require Safety Class SSC designation. Qualitatively, fire behavior without the interior laboratory walls would actually result in some hot gases from the fire rooms being pushed to adjacent laboratories rather than the corridor, thus reducing the LPF. Therefore, modeling the interior laboratory walls as intact following an earthquake is considered both the expected case from a seismic capacity perspective and the most conservative case from a LPF perspective.

Quantity of Combustibles: The analyses of laboratory room fires for the 2011 DSA depend on models of combustibles present. The DNFSB questions the modeled amounts of PMMA material in HS-Pu laboratory room fires: "Therefore, postulating an HS-Pu room fire that involves only combustible fuel from the fixed PMMA shielding of four gloveboxes is also a non-conservative assumption that leads to an underestimation of LPF values and overall offsite dose consequences." In the PMMA fire, two random transient fires are assumed to ignite in the aisles between gloveboxes that have PMMA shielding. This fire (whether transient ordinary combustibles or mobile PMMA shielding) ignites the fixed PMMA, and this fire involves four surfaces of PMMA as was modeled conservatively as a medium growth fire without regard to quantity of combustibles. The PMMA is assumed to be in a vertical position and the fire grows in both the vertical direction and the horizontal direction based on data from a full scale experiment of the actual PMMA configuration. This fire is considered the base case fire establishing a heat release rate. The fire used in the DSA is actually 150% of the heat release rate of the base case fire for conservatism. This is a 3 MW fire. It is acknowledged that the DSA describes the fire as involving fixed PMMA. Portable shielding is also present and this material could fall in an unknown configuration. However, the way the fire was modeled in the DSA it does not matter whether the PMMA is fixed or portable, the DSA includes two random fires igniting four vertical surfaces of PMMA with an increase to 150% of the base case heat release rate. Upward flame spread adds much greater burning area to the fire than corresponding downward or horizontal ignition (Fire Protection Handbook, Eighteenth Edition, National Fire Protection Association). Therefore, assuming four surfaces burning in a vertical configuration provides reasonable conservatism of the burning area and is considered sufficiently bounding to model the LPF.

Respirable Fraction: In the LANS analysis of seismic spill and seismic fire consequences appropriate respirable fraction (RF) parameter values were used for all of the MAR forms considered for the relevant release mechanism or stress (i.e. spill and fire). For heat-source plutonium (HS-Pu) powder a spill RF of 0.3, the bounding value directed by DOE-HDBK-3010, was used and a thermal stress (i.e. fire) RF of 0.1, which is 10 times more than the bounding value directed by DOE-HDBK-3010 was used. The DNFSB May 8, 2012 memorandum questions the applicability of these RF values in the 2011 TA55 DSA seismic accident analysis. Additionally their memorandum indicates that the 2011 R1.0 DSA revision lacked sufficient clarity about assumptions of glovebox seismic qualification in the seismic accident due to a statement in one of the DSA references. To address both the applicability of the DOE-HDBK-3010 RF values to HS-Pu powder and to clarify the assumptions of the DSA regarding the fact that no consequence reduction was credited to glovebox stands, several sections of the DSA were updated in Revision 1.2 of the 2011 TA55 DSA (submitted to LASO, with a courtesy copy provided to the DNFSB, May 9, 2012 and approved by LASO via SER May 21, 2012). Revision 1.2 made the following clarifications:

- The RF values used in the TA-55 DSA for HS-Pu powder all equal or exceed the bounding values directed by DOE-HDBK-3010-94 for powder under the appropriate insult (a practice supported by DOE-STD-3009 and consistent with analyses involving similar material at Savannah River Site)
- The choice of RF = 1 for other previous analyses that were not revisited for the 2011 DSA do not necessarily dictate the use of that value for the revised seismic accident in the 2011 DSA.
- The current version of the DSA includes updated references and a revised discussion in support of the applicability of DOE-HDBK-3010 to HS-Pu powder
- Clarification that although a cited reference mentions seismically-qualified glovebox stands, the context of that citation, in supporting the general applicability of using DOE-HDBK-3010 RF values for HS-Pu powder, does not imply that seismically-qualified glovebox stands are assumed in the DSA
- The seismic design basis accident (DBA) in the 2011 TA55 DSA explicitly assumes that all gloveboxes topple

With these changes, the DSA clarifies the applicability of RF parameter and the consequence assumptions for glovebox seismic qualifications.

Review of Input Documents: The DNFSB May 8, 2012 memorandum discusses the issue of review of DSA input documents with respect to the LANL calculation procedure and cites two documents as examples.

Input documents to the DSA can be considered to be grouped into three general categories: 1) Calculations that support specific conclusion for which the LANL Calculation procedure AP-341-605 is applicable; 2) codes or standards (e.g. DOE, EPA, ASME, ANSI), and 3) publications from peer reviewed journals whose use is generally accepted; and other documents such as LA-CPs, LA-URs, emails, "white papers," meeting notes whose use as inputs to the DSA is considered as a part of the overall review DSA or, if applicable, as a part of the AP-341-605 directed review of calculations. The LANL calculation procedure AP-341-605 falls under the purview of item number 1; LA-URs, etc. do not need to follow the guidance of AP-341-605.

These DOE-STD-3009-94-CN3 expectations are met at LANL via LANL institutional document SD330, R1, *LANL Quality Assurance,* which establishes the Quality Assurance (QA) program requirements for institutional implementation. Using this document and the Laboratory policies and procedures, the Laboratory implements the full scope of requirements contained in DOE Order (O) 414.1C, *Quality Assurance*, and the nuclear safety QA criteria specified by Part 10 Code of Federal Regulation (CFR) 830, *Nuclear Safety Management*, Subpart A, *Quality Assurance Requirements*. The LANL QA program was followed with a few noted exceptions. As stated previously, these shortcomings were entered into the Non Conformance Report (NCR) process when discovered. This process warrants continued improvement of reference documents in facility safety bases.

TA-55 personnel are following their NCR process to address the two identified documents and formalize the documentation of their reviews. As a result, LANL has re-reviewed the two specific references cited by the Board staff as not having received appropriate independent review. Our re-review of these input documents is summarized below:

1. Reference 3-65, LA-UR-11-01857, *Modeling the Number of Ignitions Following an Earthquake: Developing Prediction Limits for Overdispersed Count Data*

The cited LA-UR document was a reference (and excerpts were included as an appendix) in the formal calculation SB-DO:CALC-10-021 Rev. 0, "PF-4 Fires After An Earthquake", which was independently reviewed. Consistent with the expectations delineated in DOE STD 3009 the approach provides an auditable trail that was sufficient for review and approval. While the DNFSB has expressed a concern with this LA-UR document's apparent lack of review it should be noted that the information provided in this evaluation of the number of fires after an earthquake was not used as the sole basis for the accident or the calculated consequences of the accident. In accordance with DOE STD 3009 it is only necessary to provide a reasonable argument to support the assumption that a single or multiple fires in PF-4 are more credible than a facility wide fire being initiated by an earthquake. The LA-UR document therefore is only a support document and does not explicitly address the fire model that was used to support the estimation of dose to the MEOI. Therefore, based on the end use of the information and the expectations in DOE STD 3009 it is concluded that the appropriate level of review was performed. However, as a conservative measure, an additional independent review of the methodology was performed. The conclusion of the independent reviewer (D.G. Honegger, 2011) was that "the LANS methodology could overestimate the likelihood of ignitions at a PGA of 0.50g by several orders of magnitude." Based on this conclusion the bounding estimate of a single random fire is appropriately conservative for use in the DSA.

2. Reference 3-112, Memo SB-PF:10-007, *Statistical Evaluation of Damage Ratio Data*

For similar reasons to those identified for item #1 above this memorandum was used in support of assumptions rather than as a basis for a calculation. The test results, which are the sole basis for the assignment of a Damage Ratio (DR), were independently reviewed and validated in the Southwest Research Institutes (SWRI) Final Report on the testing of the containers. The data from the SWRI final report was used in the memorandum SB-PF:10-007, which provides the auditable trail. In addition, as stated in the 2011 TA55 DSA, the test plan for the containers was reviewed and approved by DOE LASO.

"Complete testing protocols incorporating the recommendations and testing parameters from the reference memo are described in TA55-PLAN-054-R1 *Fire-Rated Containers Test Plan* [Ref. 103]. This test plan was reviewed and approved by DOE LASO via formal memo 19.1 NSM:MH-254297, *Approval of TA-55 Fire-Rated Containers Test Plan* [Ref. 104] prior to testing. The test criteria were selected to provide a bounding set of thermal and mechanical challenges to the containers to ensure a conservative measure of damage ratio."

Consistent with DOE-STD-3009-94-CN3, LANL uses a graded approach and engineering judgment regarding the independent review requirements related to DSA input documents. As stated in DOE-STD-3009-94-CN3:

> "Hazard Category 2 and 3 facilities do not have the consequence potential associated with Hazard Category 1 facilities, such as Class A reactors. Consequently, in keeping with the use of a graded approach, the means of safety assurance expected of Class A reactors, such as formal design reconstitution and full, formal environmental qualification, are generally unsuitable for Hazard Category 2 and 3 facilities. DSA preparers (and subsequent reviewers) should not expect this level of information to be attained, especially for SSCs for which the original design is not documented." (Ch. 4, *Safety Structures, Systems, and Components,* p. 56)
>
> "Engineering judgment may be used to develop performance criteria for existing safety SSCs (i.e., already designed) where documentation of design and operational responses may not exist. In determining performance criteria for safety-class SSCs, existing criteria traditionally associated with safety-class designation, such as single failure criteria, should be considered in the judgment process. However, for existing SSCs, formal design comparison and compliance with traditional safety-class performance criteria is not required." (Sect. 4.3.X.4, *System Evaluation*, p. 59)

As allowed for by DOE-STD-3009-94-CN3 independent review is not performed unless the DSA input document represents the essential elements or the basis for which a safety control can be credited in the DSA or if the document is essential to the conclusions of the accident analysis. In other words if the input document is in support of calculations, assumptions, or conclusions reached in the DSA it is only necessary to provide an auditable trail of information and detailed or formal independent review is not required. This concept is described in DOE STD 3009, which states on page 49 of Section 3.4 'Accident Analysis:

> "All assumptions made in the accident analysis (i.e., defining points in scenario progression) are to be validated as part of the accident analysis activity...
>
> The above guidance is not meant to imply that the DSA must contain detailed validations for all assumptions. The DSA needs to present information at a level that is considered sufficient for review and approval of the DSA. Referencing an auditable trail of information as part of the controlled supporting documentation is acceptable."

During the FY13 Annual Updates to DSA, LANL will review a sampling of other references used in DSAs for compliance with the LANL calculation procedure. The LANL NCR process will be followed in the event that this re-evaluation effort identifies any issues. Corrective Action items have been initiated to track this effort.

Seismically Induced Basement Fire: The 2011 TA55 DSA does not explicitly analyze a seismically induced fire in the PF-4 basement. The DNFSB May 8, 2012 memorandum observes this, discusses the characteristics of the basement (i.e. presence of switchgear, amount of MAR, and high LPF for one specific previously analyzed pool fire scenario), and suggests that: "The consequences from a fire in the basement should either be accounted for or additional technical justification should be provided to defend the assumption that a seismically-induced fire in the facility basement is not credible."

While the 2011 TA55 DSA did not explicitly evaluate a seismically induced fire in the basement, the consequences of the seismic accident analyzed in the 2011 TA55 DSA with multiple fires (one random and three deterministic) in the first floor conservatively bound the consequences of a scenario with one random seismically induced fire in the PF-4 basement and three deterministic fires in the first floor. The probabilistic analysis that supported the DSA in determining the low likelihood of one random fire was linearly dependent on floor area, thus the calculation may be qualitatively extended to consider the basement simply by doubling the probability to account for the additional floor space that the basement would represent (i.e. doubling of floor space). Such an upward modification of the probability would still result in less than one random ignition in the whole facility, therefore it is reasonable to consider either a random seismically induced fire in the basement or the first floor of PF-4, but it is not reasonable to consider random fires in both locations.

In considering a basement fire in lieu of the previously analyzed random fire in the first floor, two phenomena should be qualitatively considered:

- First, the previously analyzed random location was deliberately chosen to be a laboratory room containing a large amount of HS-Pu MAR such that the MEOI dose from a fire in that room would be expected (based upon the analysis in the DSA of a room fire in a similar HS-Pu laboratory room) to significantly exceed the dose from any single fire in the basement as calculated in the DSA. The room was preferentially chosen to be located near the exit doors to maximize the amount of MAR escaping to the environment.

- Secondly the fire LPF as calculated to support the seismic accident of the 2011 TA55 DSA was highly dependent on the placement of the first floor random fire, and thus without a fire in that location all of the thermally impacted first floor MAR would be subjected to an LPF that was significantly less than 0.18. A sensitivity study performed as a part of the development of the bounding LPF demonstrated that placing the random fire in the analyzed first floor location essentially doubled the first floor fire LPF. If the first floor seismic fire were reanalyzed with such a significantly reduced fire LPF then the corresponding reduction of dose consequences would, when combined with additional consequences from any of the previously evaluated bounding basement fires, be expected to result in an overall reduction of MEOI dose.

However, as discussed above the inclusion of the basement floor space to the seismic analysis would have slightly increased the probability of the random facility fire. Therefore, this information was evaluated through the LANL New Information process and a Potential Inadequacy of the Safety Analysis (PISA) was declared.

Probabilistic Fire Analysis: The DNFSB May 8, 2012 memorandum discusses the probabilistic fire analysis that supported the 2011 DSA with several comments regarding the applicability of that analysis. One of the specific comments was "Additionally, site analysts did not effectively use the guidance provided by the DOE Risk Assessment Technical Expert Working Group that was established in response to the Board Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities*, to assist in the appropriate preparation of quantitative risk assessments.

Given the uncertainties and potential issues related to direct applicability of the database for estimating the likelihood of a post-seismic fire in PF-4, the extrapolation of available data to PF-4 is conservative based on the following:

- "A spark from a short circuit more likely turns into a fire in a wood building than in a non-wood building." (ASCE/NFPA Monograph 26, *Fire Following Earthquake*, 2005, pg. 112). Residential wood buildings dominate the database and their inclusion is conservative compared to the PF-4 materials of construction.
- Data cover the time period of the first five days after an earthquake. For the PF-4 accident analysis the consideration is a 2-hr event (DOE STD 3009, Appendix A).
- "... data from the 1994 Northridge earthquake, which indicate that about 50% of earthquake-related fires are reported within several hours of the earthquake." (ASCE/NFPA Monograph 26, *Fire Following Earthquake*, 2005, pg. 115) It can be expected that about 50% of the fires reported in the data occurred more than several hours, up to several days, after the earthquake events.
- The data analysis method determined the frequency of seismically-induced fire on an area dependent basis. The predicted one random fire for the facility was conservatively assigned (without frequency reduction) to the worst-case consequence room. This assumption alone results in an approximately one order of magnitude frequency overestimate for the random fire component of this accident evaluation.
- Of the 48 materials known to be first ignited after the 1994 Northridge earthquake, 37 of these materials are not present in PF-4. (ASCE/NFPA Monograph 26, *Fire Following Earthquake*, 2005, Tbl. 4-6). Thus, earthquake fire data from the general built environment will be conservative to use for predictive estimates of ignitions in PF-4.
- "*A typical cause of these later ignitions is the restoration of electric power. When power is restored, short circuits that occurred due to the earthquake become energized and can ignite fires.*" (ASCE/NFPA Monograph 26, *Fire Following Earthquake*, 2005, pg. 115).). It is reasonable to assume that in the highly regulated environment of PF-4 restoration of electrical power will be orchestrated in detail with intense supervision, unlike what typically occurrs in the general built environment. Therefore fires ignited after an earthquake in PF-4 are less likely.

The approach used in the DSA reference for estimating the number of post-seismic ignitions (SB-DO:CALC:10-021) can be compared to the prediction of facilty wide seismically-induced fire probability with NUREG-5580 (*Evaluation of Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment*, Lambright, et.al.), which used a data base of electric power and industrial facilities only. The overall prediction of seismically-induced fire probability in NUREG-5580 is 3.7%, which is within a factor of three of that described in SB-DO:CALC:10-021.

The DOE Risk Assessment Technical Expert Working Group prepared a draft standard for DEVELOPMENT AND USE OF PROBABILISTIC RISK ASSESSMENTS IN DEPARTMENT OF ENERGY NUCLEAR SAFETY APPLICATIONS. This standard was considered and discussed in Revision 0 of the 2011 TA-55 DSA. However, rather than being a full PRA the analysis of concern related to post seismic event fires was a simple and bounding probabilistic determination of the likelihood of a fire starting in PF-4 to meet the expectation of DOE-STD-3009 that

> "The unmitigated release should characterize both the energies driving the release, and the release fractions in accordance with the physical realities of the accident phenomena at a given facility or process."

A floor-wide fire of PF-4 was not considered to be credible and this probability analysis was used in addition to engineering judgement regarding the assumption of several "deterministic" fires to guide the development of an accident scenario with 4 fires in the first floor that was then analyzed in a deterministic fashion. Thus, the approach to PRA outlined in the draft standard was not required to be pursued in detail as, consistent with the philosophy of Section 4.1.1.3 of the draft standard, the application of the probabilistic fire analysis would not have led to unique TSR controls.
The 2012 Annual Update of the TA-55 DSA will include clarifying text for the seismicially induced fire accident analysis to the effect that, four deterministic fires were assumed based on the location of ignition sources and MAR. The four fires are considered conservative based upon information from the probabalisitic analysis.

Conclusion: In summary, LANS considers that the analysis provided in the 2011 TA55 DSA is both conservative and appropriate in providing reasonable assurance of adequate protection of workers, the public, and the environment from adverse consequences, taking into account the work to be performed and the associated hazards [10 CFR 830.4(c)].