Final Documented Safety Analysis (DSA) Technical Area 54, Area G
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Los Alamos Site Operations

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TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

1.1 Facility Name and Hazard Classification

Los Alamos National Laboratory memorandum FWO-WFM 03-050 transmitted the Technical Area 54 (TA-54) Area G Documented Safety Analysis (DSA) and Technical Safety Requirements (TSRs) to the NNSA for approval on April 9, 2003. The NNSA has performed a detailed technical review of the TA-54 Area G DSA and TSRs. During the review, it was discovered that major modifications to the Area G TSRs were required before they could be approved. Issues included safety controls that were missing from the TSRs. The missing safety controls issue was traced by the Senior Authorization Basis Manager (SABM) and SABT staff in meetings with the contractor, with FWO Division personnel and Performance Surety Division personnel present, to modification of the TSRs by Los Alamos National Laboratory personnel after delivery of the Safety Basis documentation by the subcontractor. This observation was documented. Through the rigorous implementation of appropriate and corrected controls in accordance with DOE-STD-3009-94 and 10CFR830 Subpart B requirements, the implementation of SER Conditions of Approval, the removal of the 2000 Quick-to-WIPP waste storage drums to the Waste Isolation Pilot Plant (WIPP) by September of 2004, and the rewrite of the TSRs, NNSA has determined that the consequences to the MEOI and workers from the accident scenarios have either been prevented or significantly reduced per the requirements of the DOE-STD-3009-94 and 10CFR830 Subpart B safe harbor. After successful implementation of NNSA Conditions of Approval, safety class and safety significant controls, administrative control programs, design features and defense in depth controls, the NNSA can accept the risk of continued operation of TA-54 Area G Waste Storage Facility.

This safety evaluation report (SER) summarizes the basis upon which the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA) approves the Documented Safety Analysis (DSA) and the attached Technical Safety Requirements (TSR) for Technical Area 54 (TA-54) Area G at the Los Alamos National Laboratory (LANL). **Where there are differences between the DSA/TSRs and this SER, the SER is the overriding document.**

The DSA and TSR approved by this SER replace:

- A Safety Analysis Report (SAR), dated August 30, 1995,
- Technical Safety Requirements (TSRs), dated August 30, 1995, and
- A Safety Evaluation Report (SER), transmitted by DOE memorandum, *"Approval of Safety Analysis Report (SAR)/Technical Safety Requirements (TSRs) for Los Alamos National Laboratory (LANL) TA-54, Area G", Los Alamos, New Mexico*, September 1, 1995.

Quality Issues. While the NNSA performed several interim reviews of the subject DSA, the documents submitted to the NNSA for final approval contained significant deficiencies, falling short of approval criteria (documented in both LANL and NNSA Authorization Basis (AB) Review Procedures) for meeting 10CFR830 Subpart B requirements. The NNSA believes that a full independent quality assurance review of the 100% DSA and TSRs by fully qualified LANL Safety Analysts did not occur as committed to by the Laboratory in a memorandum from LANL Associate Director for Operations to the then NNSA Albuquerque Operations Office Manager. A root cause to the lack of a full quality review by LANL is the fact that NNSA personnel were told by LANL personnel that LANL has no fully qualified Safety Analysts. This training and qualification issue was first documented by LANL in the September 1999 McClure Report (LA-CP-99-259, *Authorization Basis Quality Review Report Summary of Findings and Examinations of Causes for LANL Authorization Basis Deficiencies).* The lack of this full quality/independent review has resulted in a DSA and TSRs submitted to NNSA for approval that were lacking in quality and should have been rejected per LANL's and NNSA's criteria. In the interests of nuclear safety NNSA decided to provide significant technical assistance in order to prevent further delays in obtaining an adequate safety basis to replace the current inadequate safety analysis (see table below). After NNSA provided detailed technical assistance in rewriting the TSRs so that they reflect the safety analysis and can be implemented, LANL provided the revised TSRs which are attached to this SER. While being approved herein, the initial submittal of the DSA and the TSRs had many technical issues still unresolved from the previous NNSA 100% review and significant amounts of technical and logical deficiencies. Fully addressing prior NNSA comments would have prevented many of these issues. The impact from having NNSA provide this level of technical assistance is that NNSA had to reprioritize already limited resources, which significantly delayed safety basis reviews for other nuclear facilities. There is the additional impact associated with LANL's continuing difficulties in developing defensible safety bases as well as performing adequate independent reviews. A third consequence of this issue is that this SER became more complex because of explanations necessary to defend moving forward with this approval with 20 Conditions of Approval. However, in the interest of nuclear safety, the NNSA chose to provide the technical assistance to the Laboratory to raise the quality of the Area G DSA and TSRs to the acceptable standards. NNSA intervention in this regard is justified, in NNSA's view, by the inadequacies in the current Area G safety basis and the significant increase in nuclear safety that can be achieved even by a SER corrected AB under the new 10CFR830 Subpart B requirements. The following table illustrates how the previous TA-54, Area G Site Safety Basis, approved in 1995 by the DOE Albuquerque Operations Office, either underestimated the offsite doses due to postulated bounding accidents at Area G or did not evaluate the accidents altogether. It should be noted that in 1995, the Albuquerque Operations Office also did not have any fully qualified Safety Analysts, a situation not true today in the Los Alamos Site Office (LASO) where approval authority now resides. The 1995 safety basis stated that the highest postulated offsite dose to the public to be 12 rem, while the more rigorous current analysis reveals bounding offsite doses in the several hundred to thousand rem ranges to the public. This translates into missing or inadequate number, type, level of safety controls to protect the public, workers, and environment in the old, 1995 approved safety basis.

Accident Public Consequence Comparison (1995 Area G Safety basis vs. new 2003 Safety Basis)			
Accident Type	**New 2003 Safety Basis Public Dose Estimates Maximum dose for scenerios**	**Previous 1995 Safety Basis Public Dose Estimates**	**Multiplicative Consequence Increase Factor (Old Safety Basus vs New)**
1. Operational Spill (drum drop, drum pallet drop, transport vehicle/drum stack impact)	554 rem	2.4 CEDE to MEOI (single container handling accident)	231
2. Transport accident with fire of transported drums	192 rem	**NOT ANALYZED or CONSIDERED**	16*
3. Flammable gas buildup with drum deflagration	139 rem	12 rem to MEOI (multiple drum spill is closest comparison)	12
4. Waste Storage Dome drum fire	622 rem	**NOT ANALYZED or CONSIDERED**	52*
5. Wild fire impacting multiple domes	352 rem	**NOT ANALYZED or CONSIDERED**	29*
6. Earthquake	919 rem	**NOT ANALYZED**	

Accident Public Consequence Comparison (1995 Area G Safety basis vs. new 2003 Safety Basis)			
Accident Type	**New 2003 Safety Basis Public Dose Estimates Maximum dose for scenerios**	**Previous 1995 Safety Basis Public Dose Estimates**	**Multiplicative Consequence Increase Factor (Old Safety Basus vs New)**
a. With no fire b. With Fire	731 rem	**or CONSIDERED**	77* 61*
7. High wind induced dome structural failure	79 rem	**NOT ANALYZED or CONSIDERED**	61*
8. Aircraft Crash Accident into Domes	1795 rem	**NOT ANALYZED or CONSIDERED**	150*
9. Fire in Tritium sheds	0.8 rem	**NOT ANALYZED or CONSIDERED**	0.07*
10 perational Spill during shaft replacement	28 rem	**0.9 rem Tritium (single) drum drop down shaft is closes analog**	2

*** = Though not analyzed at all in the old 1995 Safety Basis, this number is compared to previous maximum dose in the 1995 safety basis**

As discussed above, the previous authorization basis (AB) lacked the depth and breadth required per DOE-STD-3009 for a Category 2 nuclear facility including issues such as incorrect bounding accident consequence dose estimates to the public and missing accidents and controls for safety. This deficiency was formally documented as part of a report that NNSA had requested under the 1999 Contract because of previous systematic authorization basis deficiencies that had been noted and trended by NNSA. The report, LA-CP-99-259, *Authorization Basis Quality Review Report Summary of Findings and Examinations of Causes for LANL Authorization Basis Deficiencies* critically reviewed the quality of 10 LANL authorization bases. The discovery and documentation of SAR and TSR deficiencies led to an NNSA decision to develop an entirely new defensible authorization basis within a reasonable period of time. This NNSA decision to upgrade the existing LANL authorization bases occurred prior to the issuance of 10CFR830 Subpart B and was documented in the FY00 contract performance measures. The TA-54 Area G TSR and DSA recently produced under this mandate, and revised with NNSA technical assistance, represent a significant improvement in the TA-54 Area G authorization basis and will serve to address and control the major risks and operational hazards associated with TA-54 Area G operations. A complete summary of deficiencies contained in LA-CP-99-259 is presented in Appendix A. Following each deficiency is an explanation of how the new DSA and the attached TSRs correct the deficiency in the old, 1995 approved Safety Basis.

1.2 Facility Mission and Scope of Operations

Area G is the primary site for the disposal of low-level waste (LLW) and the storage of transuranic (TRU) waste and mixed low-level waste (MLLW) generated at the Los Alamos National Laboratory (LANL). Disposed-of LLW includes radioactively contaminated asbestos and LLW contaminated with small amounts of PCBs, bio-organics, or beryllium. MLLW is stored in inspectable arrays in a Resource Conservation and Recovery Act (RCRA)-permitted dome, except for small amounts of tritium-contaminated MLLW that is stored in sheds.

TRU waste destined for the Waste Isolation Pilot Plant (WIPP) is stored in inspectable arrays. Radioactive wastes that have significantly higher dose rates and that pose an unacceptable exposure to workers are placed in shafts for storage to meet ALARA requirements.

Area G facility operations are the responsibility of the Facility and Waste Operations Division's Waste Facilities Management (FWO-WFM) group with several other groups and organizations supporting the WFM responsibilities at Area G. The primary tenant at Area G is the Solid Waste Operations (FWO-SWO) group. This group is responsible for the LLW, MLLW, and TRU operations discussed above. The only other major tenant at Area G is the Risk Reduction and Environmental Stewardship Division, which is responsible for certification of LANL's TRU waste to the WIPP Waste Acceptance Criteria (WAC). Operations associated with waste management at Area G include radioactive waste receipt, handling, repackaging, storage, container inspection, decontamination, waste characterization and verification (both intrusive and non-intrusive), size and volume reduction, disposal, retrieval of legacy waste, environmental monitoring, and other operations attendant to the management of waste. The area has been in use since 1957 and is expected to remain active through the foreseeable future.

MLLW and TRU are managed according to applicable regulations. Prior to these regulations all waste forms were land-disposed (buried) in pits, retrievably stored below grade, or stored on earth-covered surface pads at this site. RCRA now prohibits this practice, and all new mixed waste received is currently stored within aboveground structures (domes). Retrievably stored TRU wastes at Area G, if acceptable under the WIPP WAC, will be prepared for eventual shipment to the WIPP. TRU waste not meeting the WIPP WAC and MLLW with no treatment path will be held in storage until process activities are developed to treat and prepare this waste for acceptance at WIPP or another TSDF.

The major structures and facilities include:

Waste Assay Facility, Building 54-2

Drum Preparation Facility, Building 54-33

Waste Storage Domes, Buildings 54-48, 54-49, 54-153, 54-224, 54-226, 54-229, 54-230, 54-231, 54-232, 54-283, and 54-375

Waste Compactor Facility, Building 54-281

Tritium Monitoring and Storage Sheds, Buildings 54-1027, 54-1028, 54-1030, and 54-1041

Sort, Segregation, and Decontamination (SSD) Facility, relocatable

Currently active LLW disposal pits (54-15, 54-31, 54-38, and 54-39)

Currently active shafts for retrievable storage and disposal

1.3 Radioactive Waste Material at TA-54 Area G:

A large number of different radionuclides are present in the waste materials at Area G. The radionuclides of concern are the transuranics and tritium. Fission products are also present but these are less of a concern because they are disposed of in pits and shafts and not a major component of surface storage. Radionuclides are found in a variety of forms, including

Surface contamination on paper and plastic trash products and glassware,

Contaminated personal protective equipment (PPE),

Surface contamination on metallic components, such as gloveboxes,

Constituent mixes in sludges and cementitious solids (cemented matrix),

Salt cake,

Metal waste (restricted to certain materials, such as uranium turnings), and

Contaminated filters and sieves.

Most radioactive material is isolated and confined inside waste containers. Certain large waste components are isolated in the shafts. In general, each major waste type is packaged and dispositioned as follows:

- TRU waste is packaged in 55-gal drums, 85-gal drums, standard waste boxes (SWBs), other metal boxes, or in wood crates. Wood crates are used primarily to package large, contaminated metal components, such as gloveboxes, piping, and ducting, and for contaminated high efficiency particulate air (HEPA) filters. TRU waste is stored in Area G surface structures. Some TRU waste containers have in the past been buried on pads or in pits or trenches. TRU waste has been retrieved from pads and transferred to surface storage. This material is addressed in this DSA. TRU waste buried in pits or trenches will remain there for the foreseeable future. *(Note: In this new DSA, LANL has utilized inadequate damage ratio arguments showing the damage ratio to be zero for fires, seismic, and aircraft crashes for accidents involving material in pits, trenches and storage shafts. As a compensatory measure, the NNSA has reinstated the earth overburden for disposal pits and storage shaft covers as TSR design features (this was one of the safety controls removed by LANL personnel after submittal by the subcontractor.)*
- Tritium waste is primarily residual tritium within molecular sieves or on metal components. The tritium is chemically bound to the metallic material in the sieves (known as "getter" material) or to the metal components in a hydride form at room temperature. To be released from the metallic material, the tritium must be heated. Containers with tritium wastes are normally double-walled, or in containers that are overpacked into larger containers. Tritium waste containers are stored in the tritium sheds or disposed of in the shafts. Tritium-contaminated metal components are typically disposed of in shafts.
- Most LLW is TRU-contaminated waste that is packaged in a variety of containers, including metal containers (drums, boxes, and bins), plastic drums and bags, and cardboard boxes. Some of these packages are compacted at Area G and consolidated into metal waste boxes. LLW includes smaller quantities of other radionuclides, but TRU-contaminated items are predominant. Most of these types of packages are disposed of in large excavated pits. Each layer of containers is covered with several feet of overburden.
- Waste material containing non-TRU radionuclides with gamma activity are also classified as LLW. Some of these items can be disposed of in the pits, but high-gamma items are disposed of in shafts. These items can be packaged in a variety of waste containers, but they also include large, metal components, such as the targets from the accelerator facility, that are not packaged. The shafts are covered with steel plates or plugged shut with concrete or soil.
- MLLW is packaged in metal or plastic drums or other metal containers and stored in surface structures at Area G.

1.4 Major Facility Hazards and Accident Scenarios

The major hazard to the public and workers results from accidental releases of dispersed radioactive material as a result of postulated accidents related to the transport, storage, and evaluation of waste materials during operational and natural phenomenon events. The hazard evaluation produced ten (10) evaluation basis accidents (EBA) for additional consideration in the accident analysis. These accident scenarios are representative of all postulated events that have the potential for significant consequences to the public and are selected, per the requirements of the 10CFR830 Subpart B DOE-STD-3009 Safe Harbor without regard to likelihood.

Operational Spill – TRU Waste, DSA Section 3.4.2.1

TRU Waste Transportation Accident and Fire,. DSA Section 3.4.2.2

TRU Waste Drum Deflagration Accident, DSA Section 3.4.2.3

Waste Storage Dome Fire, DSA Section 3.4.2.4

Brush/Forest Fire Spreads to Multiple Waste Storage Domes, DSA Section 3.4.2.5

Earthquake, DSA Section 3.4.2.6

Waste Storage Dome Structural Failure from High Wind, DSA Section 3.4.2.7

Airplane Crash into Waste Storage Dome,s DSA Section 3.4.2.8

Fire in Tritium Sheds, DSA Section 3.4.2.9

Operational Spill during Shaft Placement, DSA Section 3.4.2.10

Radiological releases from TA-54 Area G accidents were modeled using the MACCS2 computer code and fully verified by NNSA independent analyses. The accident analyses calculated the 95th percentile χ/Q accounting for variations in site boundary distances for determining radiological doses in accordance with DOE-STD-3009-94, Appendix A. NNSA modeled the release of radiological material using conservative dispersion parameters and found the χ/Q values to be conservative. Accident scenarios were reviewed and evaluated for defensibility, conservatism, and compliance with accident modeling guidance criteria presented in DOE-STD-3009-94, Appendix A; guidance for preparing a dose value for comparison to the evaluation guideline of 25 rem.

Of the ten (10) scenarios screened into the accident analysis, the largest dose to the MEOI is the result of an aircraft crash into the waste storage domes. The bounding dose calculated by LANL was 1795 Rem. NNSA review of the calculations for this accident as well as for the Waste Storage Dome Fire (3.4.2.4), Brush/Forest Fire Spreads to Multiple Waste Storage Domes (3.4.2.5), Earthquake (3.4.2.6), and Waste Storage Dome Structural Failure from High Wind (3.4.2.7) showed that some non-conservative estimates were used for a number of the parameters in the consequence calculations. NNSA determined that use of conservative values for the various parameters, such as MAR, damage ratio, airborne release fractions (ARF) and respirable fractions (RF) indicates the calculated doses may be as much as 20% greater than what was presented in the DSA as submitted. NNSA also identified a number of discrepancies in the accident calculations in the DSA as submitted. These included but were not limited to incorrect calculation of the damage ratio, lack of consideration for release mechanisms (failed to consider ARF/RF for shock-vibration), non-conservative values for material at risk (MAR). The accident analyses presented, did however, include a number of conservative assumptions, specifically the dose to source ratio for fire scenarios. The dose to source ratio value used in the accident analysis for the fire scenarios was that for a 0.1 MW fire (28.8 Rem/Pe-Ci). It is important to note that a single burning desk/chair can create fire on the order of a few magawatts. The use of the lower energy fire to calculate the dose to source ratio is conservative since the lower energy fire results in higher airborne concentrations to both onsite and offsite MEOIs since the "modeled" plume of contaminants is limited to essentially a ground-level release. NNSA's evaluation of the accident analyses shows that judiciously using conservative values for the parameters might lead to consequences being about 20% higher. Because NNSA is formally acknowledging this specific magnitude of possible increase in public doses, for the purposes of this approval, any future re-analysis of the accident scenarios covered in the DSA which produces doses which are up to 20% larger will not be treated as an Unreviewed Safety Question (USQ) based upon dose consequence increase alone. Any future errors discovered in the DSA accident consequences that exceed a 20% increase will be treated as a USQ.

Since the doses calculated by LANL are already substantially above the evaluation guideline and dose calculations are highly assumption-driven, there is little or no benefit in pursuing calculations at this time that result in higher doses to the MEOI. Had these "deficiencies" not been identified future accident calculations could easily lead to the identification of issues that would be interpreted as inadequacies in the safety analysis based upon accident dose consequences. NNSA's review has identified these inadequacies and per this SER has established an allowable upper bound as per above on the consequences for the accident scenarios. Safety-class controls have already been identified because of the calculated accident doses. NNSA has determined that recalculation of the accident scenarios and the consequences at this time would not lead to the identification of new or different Safety-Class controls, other than those already identified by LANL or in this SER.

Through the rigorous implementation of appropriate controls in accordance with 10CFR830 Subpart B and DOE-STD-3009-94 guidelines, the implementation of SER Conditions of Approval, the removal of the 2000 Quick-to-WIPP waste storage drums to the Waste Isolation Pilot Plant (WIPP) by September 2004, NNSA has determined that the consequences to the MEOI and workers from the accident scenarios have either been prevented or significantly reduced per the requirements of the DOE-STD-3009-94 and 10CFR830 Subpart B safe harbor. NNSA has determined that the risk presented by the continued operation of TA-54 AREA G as addressed in this DSA and revised TSRs (attached to this SER) is acceptable.

As a result of NNSA review of the DSA and TSRs, Conditions of Approval have been developed which LANL shall be required to implement prior to operating under the new safety basis approved herein.

1.5 Conditions of Approval

The following conditions of approval are required by the NNSA to compensate for the deficiencies identified in the DSA/TSRs. Some have be incorporated in the approved TSRs by the NNSA in Appendix B:

1. Any new operations or activities approved by this DSA shall have a readiness assessment before the start of any new operations. The safety basis (including TSRs) implementation shall identify how readiness verification will be accomplished with regard to the new safety basis. The type and level of readiness to be performed shall be established by the NNSA Los Alamos Site Operations Facility Operations Branch.

2. The facility SHALL within 45 days (if not specifically stated otherwise in the bullets below) from the SER date of approval develop and submit a safety basis Implementation Plan (IP) that includes all commitments for controls identified in the DSA, the attached TSRs and those mandated herein by the NNSA including:

    - designation of the SeaLand containers as a TSR Design Feature with implementation through an acceptable administrative control program

    - designation of the disposal pit overburden as a TSR Design Feature with accompanying administrative control program for implementation

- designation of the storage shaft steel plates as a Design Feature with accompanying administrative control program for implementation

- implementation of a incrementally decreasing Material at Risk limitation based on removal of MAR to the Waste Isolation Pilot Plant (WIPP) (See #3 below)

- designation of Vehicle Crash Barriers as a TSR Design Feature with implementation through an acceptable administrative control program

These TSR controls have been mandated into existence by the NNSA and incorporated into the TSR document by this SER. Incorporation of the applicable bases for these TSRs shall be accomplished at the first annual update of the DSA.

3. The ongoing NNSA program, Quick-to-WIPP, entails moving 2000 drums of the highest content TRU waste materials from Area G to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, NM by September 2004. NNSA has performed independent calculations to show that TRU waste material-at-risk at Area G could be reduced by up to 70%. NNSA regards this as the most viable way to increase nuclear safety at Area G. Per this SER NNSA raising the QTW program commitment to remove 2,000 drums of the highest content TRU waste materials from Area G to WIPP by September 2004 to a Safety Basis Requirement. In order to sustain these gains in nuclear safety, within 60 days of the date of this SER, LANL shall submit a plan to implement a step-down method to reduce the allowable MAR in LCO 3.1 of the TSRs following removal of the TRU waste material to WIPP.

4. Within 60 days, the LANL FWO Division shall provide the NNSA a risk-based evaluation of available electric, diesel, and LNP forklifts for the handling of radioactive waste materials at Area G. Included shall be an evaluation of requirements vs. capabilities of commercially available forklifts coupled with evaluation of potential hazards. Given the limitations of Area G fire suppression capabilities, the removal of hazards from the waste storage domes is prudent.

5. Within 60 days, LANL shall develop a method to test the TRU waste drum vent filters, to randomly test drums and determine if gas is accumulating. Alternatively, LANL shall employ a device to test the pathway, with associated performance criteria.

6. Within 120 days, the Laboratory shall provide the NNSA a plan to place wood crates and containers into metal containers or provide written justification for not doing so.

7. Within 90 days, the Laboratory shall provide the NNSA a cost benefit vs. risk evaluation of upgrading the waste storage domes, including fabric, to meet requirements in the design features in the TSRs and functional requirements in the DSA, Chapter 4.

8. Within 15 days, the Laboratory shall notify the responsible owning division of the need to change the Emergency Planning Zones for TA-54 Area G, given the postulated consequences to the worker, the environment and the public that are published in the DSA and this SER.

9. The NNSA found that integration of supplementary analyses in developing the hazards analysis was lacking. DOE Order 420.1 requires that an FHA be developed in conjunction with the DSA/TSRs and integrated into the hazards analysis. The Area G Fire Hazards Analysis conclusions and recommendations were not fully addressed in the DSA/TSRs. Furthermore, the information derived from the FHA is required to be addressed in the DSA, including the adequate disposition of FHA recommendations. Review of the Area G FHA indicates that the FHA was

developed in November 2001 and only referenced the 1995 safety basis (with a maximum offsite dose of 12 rem for all accidents), and as such is an indicator that the was obsolete and required updating. Further review of the FHA indicated that the cleanup cost at Area G as a result of an area wide fire was estimated to be "negligible" at $6/ft^2. The FHA did not address cleanup outside the domes (with the new several hundred to thousand rem offsite doses) nor was any fire hydrant information provided. Also, the recommendations made in the FHA do not appear to have been addressed in the DSA/TSRs. Below are further examples of omissions:

1. Storage configurations inside the domes were recommended to be long, narrow rows with the central isle at least twice as wide as the pile height.
2. Domes containing primarily plywood boxes and FRP boxes were recommended to have sprinklers kept in as operational a condition as possible, at least in manual mode.
3. Multiple wooden or FRP boxes were recommended to only be stored in domes equipped with sprinkler systems.
4. Others (not listed here).

The FHA recommendations need to be addressed in the DSA and TSRs and implemented to the satisfaction of the LANL Fire Chief. Additionally, it is not clear if segregation of high TRU waste content drums in domes with sprinklers could be accomplished.

As a condition of approval within 120 days, LANL shall provide an updated Fire Hazards Analysis that adequately describes the fire hazards at TA-54 Area G, the inadequacies referenced in the SER and makes appropriate recommendations for incorporation into the DSA. LANL shall incorporate these recommendations during the next annual update. In addition to other deficiencies that must be addressed, the following are required to be included in the updated FHA:

- Segregation of high content waste containers into domes that have fire suppression capability (such as Dome 54-33)
- Evaluation of incorporating reliable fire detection into waste storage domes
- Evaluation of the existing fire hydrants at Area G and feasibility of upgrading, if necessary

Separately, within 150 days, LANL shall perform cost benefit vs. risk analysis of incorporating reliable fire detection into waste storage domes. Finally, the NNSA mandated changes to the approved TSRs to ensure that the recommendations from the November 2001 FHA that was submitted with the DSA/TSR be incorporated in the TSRs.

10. Within 90 days, LANL shall provide to the NNSA TSR change pages that identify an equivalent MAR limitation expressed in plutonium-equivalent curies (PE-Ci) for the total Area G below ground inventory in LCO 3.4 (item 1). The LCO is currently expressed in curies. It is imperative that a conversion based on isotopic composition be provided such that the NNSA can evaluate the relationship between inventory and corresponding offsite dose consequences. It should be noted that the assumed MAR for accident scenarios in the hazards analysis involving disposal pits and shafts was expressed in PE-Ci.

11. Within 180 days, LANL shall provide the NNSA a rigorous technical analysis of the lightning strike frequency for the waste storage domes at TA-54 Area G performed by a recognized expert in the field with further recommendations for cost effective risk reduction in a formal report. Independent calculations by the NNSA, shown in Appendix C, indicate that the strike frequency that is presented in the DSA (Appendix 3H) was not evaluated utilizing the currently accepted methodology and is not conservative. NNSA preliminary calculations indicate the annual expected number of lightning strikes on domes at TA-54 Area G is approximately 1.4 strikes on Domes/year, which is greater than that published in the DSA (1.0 strikes/year). In the interim, by

this SER, the NNSA accepts the risk associated with this potentially non-conservative value for lightning strike frequency pending more rigorous analysis by a lightning expert and any USQ evaluations conducted in the interim (180 days) shall be against the NNSA-derived analysis in Appendix C.

12. In the first annual update to the DSA/TSRs, the Laboratory shall perform a full technical quality review by qualified safety analysts to address issues highlighted in Appendix B, but prevalent throughout the DSA and TSRs. There were numerous issues in the DSA and TSRs that had to do with the miscalculations, misstatements, use of incorrect values, etc. that detract from the quality of the document. While there was no impact that was unanalyzed by NNSA and corrected, document quality is lacking. NNSA's expectation is that the documents have been thoroughly reviewed by qualified production personnel, technical editors and by a qualified LANL Independent Review Team prior to submittal. NNSA's function is <u>not</u> one of quality assurance, but rather of Approval Authority. The NNSA would encourage the Laboratory to place more emphasis on quality.

13. In the first annual update to the DSA, the Laboratory shall provide defensible rationale for the damage ratios utilized in the DSA and Material at Risk determinations for accident scenarios.

14. In the first annual update to the DSA, LANL shall correct the cited release fraction (RF) for the shock-vibration release of surface-contaminated combustibles & non-combustibles (incorrectly cited as RF 0.1 in the equations). It was correctly cited in the text but incorrectly applied in the equations.

15. In the first annual update of the DSA, the LANL shall review the entire HA and the DSA and correct all inconsistencies with it's stated methodology for hazards and accident analyses and ensure that approved methodology for screening in accidents into the accident analyses is utilized. The use of risk determinations for screening accidents for further analyses is not in accordance with DOE-STD-3009-94, a safe harbor under 10CFR830 Subpart B. Additionally, the facility shall update the screening criteria for those accidents that screen into the accident analysis and ensure that the text **<u>and</u>** the tables are consistent and support the conclusions in the DSA. In the DSA, the facility did not update Table 3-8 to include methodology for screening in accidents with postulated consequences of 5 <25 Rem to the maximally exposed offsite individual.

16. In the first annual update of the DSA, LANL shall provide detailed justification for the assumption of three-high stacking of 85-gallon drums. This may be a typical facility configuration. However, this assumption was not analyzed in the DSA or protected by the TSRs. LANL shall provide analysis to support this assumption in the DSA or provide analysis for other potential stacking configurations with associated TSR change pages. In the interim, stacking of 85-gallon drums shall be limited to 2 high as is analyzed in Chapter 3 of the DSA and documented in the TSRs approved herein.

17. At the first annual update of the DSA, LANL shall ensure consistency throughout the DSA for the stated radioactive material limits. The TSR radioactive material limit derived in the seismic accident evaluation is different from the stated limits elsewhere in the document.

18. In the first annual update to the DSA, LANL shall correct the PC-3 wind loading to reflect 117 mph and ensure the correct value is used consistently.

19. In the first annual update to the DSA, LANL shall clarify PC-3 snow loading for the waste storage domes and ensure the correct value is used consistently.

20. In the first annual update to the DSA, LANL shall incorporate the definitions of IN-SERVICE INSPECTIONS (ISI) and SAFE CONFIGURATION in the DSA as was done in the approved in the TSRs.

1.6 Summary of Acceptability of TA-54 Area G DSA and TSRs

Because of the nature of operations at TA-54 Area G, the resultant risks, and the effectiveness of proposed controls approved in this SER, NNSA views the long term reduction of MAR as the most effective method of reducing the off-site consequences to the public. The ongoing NNSA program, Quick-to-WIPP, entails moving 2000 drums of TRU waste materials from Area G to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, NM by September 2004. NNSA has performed independent calculations demonstrating that TRU waste material-at-risk inventory at Area G could be reduced by 70% or more. LANL has formally stated that there is no higher nuclear safety priority at LANL than removing the 2000 high activity dispersible waste drums at Area G to WIPP. NNSA is in full agreement with this statement and regards this as the most viable way to increase nuclear safety and reduce risk at Area G. It is therefore imperative from a risk perspective that the high activity dispersible waste (2000 drums) be removed from TA-54 Area G to WIPP as soon as possible as a safety priority at LANL. In order to sustain these gains in nuclear safety, the LANL shall submit a plan to implement a step-down method to reduce the LCO MAR limitation in the TSRs following removal of the TRU waste material to WIPP. This is to ensure that MAR does not reach levels that could result in off-site consequences such as those currently analyzed in the DSA (and the revised accident analysis).

Through the rigorous implementation of appropriate controls in accordance with DOE-STD-3009-94 guidelines, the implementation of SER Conditions of Approval, the removal of the 2000 Quick-to-WIPP waste storage drums to the Waste Isolation Pilot Plant (WIPP) by September 2004, NNSA has determined that the consequences to the MEOI and workers from the accident scenarios have either been prevented or significantly reduced per the requirements of the DOE-STD-3009-94 and 10CFR830 Subpart B safe harbor. After successful implementation of NNSA Conditions of Approval, safety class and safety significant controls, administrative control programs, design features and defense in depth controls, the NNSA can accept the risk of operations for continued operation of TA-54 Area G facility.

2.0 REVIEW PROCESS

The NNSA conducted interim reviews of the TA-54 Area G DSA at the 30%, 70%, and 90% levels of completion, as well as two full reviews of the DSA/TSRs at the 100% level. The first 100% review conducted in February 2003 resulted in the DSA and TSRs being returned to the Laboratory for correction of significant deficiencies. Several walkdowns of the facility were conducted by the NNSA, the last being prior to the first 100% DSA/TSR review. At a 30% level, the review that was conducted evaluated the basis and conclusion of the preliminary hazards analysis and draft Chapters 1 and 2. The 70% review included (1) a draft accident analysis, (2) completed Chapters 1 and 2, (3) proposed safety class SSCs, (4) facility responses to the NNSA's 30% review comments, and (5) modeling by the NNSA of airborne release fractions as well as dispersion modeling. The 90% included a complete draft of the DSA and responses to the NNSA's 70% comments. The 90% did not include a draft of the TSRs as they were not ready for review. The 100% review included a review of the complete hazards analysis, DSA and TSRs, including supporting information such as the Fire Hazards Analysis, Critical Safety Evaluation, and Seismic Evaluation. Also reviewed was the LANL resolution of NNSA comments. For each of the above-mentioned reviews, the NNSA met with the LANL facility and Safety Basis Office to present draft comments to ensure each was understood, applicable and substantive. At each level of review, the NNSA provided the Laboratory substantive technical comments identifying technical deficiencies in the DSA.

Facility walk-downs were conducted early in the review process and prior to each milestone review (30%, 70%, 90% and 100%). The NNSA performed independent calculations and computer modeling evaluations to validate the accident analysis. The review team also compared the results of the HA with similar analyses for other LANL nuclear facilities with hazards of a similar significance and found them to be comparable. NNSA also made efforts to cross reference deficiencies with safety bases at other LANL nuclear facilities. For instance, an issue was identified early in the first 100% review regarding LANL's use of non-conservative risk ranking tables for screening accidents into the accident analysis. Investigation revealed that this deficient methodology had been utilized on other DSAs at LANL.

3.0 BASE INFORMATION

The submitted TA-54 Area G DSA and TSRs followed DOE-STD-3009-94 format. Chapter 1 provides the site, environment, natural phenomena, external man-made threats, and nearby facility descriptions. Also in Chapter 1 was information necessary for identifying and evaluating potential external event initiators and for analyzing potential accident consequences.

The scope of Chapter 1 included the following topics:

- The location of Area G within the state and county and its proximity to the public, to other Laboratory facilities, and to other land holdings;
- Characteristics of the surrounding environment that influence the design, operations, and safety of Area G facilities;
- Historical basis of the natural characteristics for the site, including meteorology, hydrology, geology, seismology, volcanology, and other natural phenomena;
- The design - or evaluation-basis natural phenomena to be examined;
- Population location and density, population sheltering, and other aspects of the surrounding area related to protecting the health and safety of the public;
- The points where the DOE evaluation guidelines apply, both onsite and offsite;
- Man-made external events that could impact the Area G facilities; and
- Nearby Laboratory operations that could impact the Area G facilities.

Chapter 2 provided information regarding the description of the Area G site and its facilities, structures, and processes to support the assumptions used in the hazard and accident analysis. Included were descriptions of the major facilities and structures necessary to understand the hazard and accident analysis. Provided were:

- Overview of the Area G site, including its mission and history.
- Description of the Area G site facilities and design basis.
- Description of process systems and constituents components.
- Description of confinement systems.

- Description of safety support systems.
- Description of site utilities.
- Description of auxiliary systems and support systems.

Chapter 3 described the hazard and accident analyses performed based on DOE-STD-3009-94 and analyzed the hazards and accidents postulated to occur from Area G operations. The operations included were storing transuranic (TRU) wastes in domes and shafts, characterizing TRU waste, disposing of low-level wastes (LLW) in shafts and pits, reducing the volume of LLW, and storing mixed LLW (MLLW) and tritium waste. General facility hazards, such as those associated with operating machinery and heavy equipment, and natural phenomena hazards were also considered in the analyses.

Chapter 4 provided detail on those facility structures, systems, and components (SSCs) classified as safety-class (SC) or safety-significant (SS) as a result of the hazard and accident analyses in Chapter 3. The structure and content of this chapter followed the outline in Chapter 4 of DOE-STD-3009. The following SSCs were identified in Chapter 3 as being the most important to safety. Their safety functions contribute substantially to preventing or mitigating the limiting accident scenarios evaluated in the accident analysis, or by providing critical defense-in-depth, or by providing for worker safety in potentially life-threatening or disabling situations:

- Transuranic (TRU) waste containers;
- Banding for drums on pallets;
- Waste storage dome door restraints;
- Waste storage domes, and
- Lightning protection system
- Storage Shaft Covers*
- Disposal Pit Overburden*
- Vehicle Crash Barriers*
- Sealand Containers* (or equivalent)

*** Designated Design Features by the NNSA in this SER.**

Chapter 5 provided a derivation of the Technical Safety Requirements. The TSRs consisted primarily of:

- Inventory limits to maintain the operations within the safety analysis basis;
- Administrative controls (ACs);
- Requirements for passive design features (safety-class [SC] and safety-significant [SS] structures, systems, and components [SSCs]); and
- Commitments to safety management programs.

Chapter 6 provided a summary description of the key features of the various safety programs as they relate to TA-54 Area G. These programs are necessary to ensure the safe operation of the facility.

- Prevention of Inadvertent Criticality Program (6.3.1)

- Radiation Protection Program (6.3.2)
- Hazardous Material Protection Program (6.3.3)
- Radioactive and Hazardous Waste Management Program (6.3.4)
- Initial Testing, In-Service Surveillance, and Maintenance (6.3.5)
- Operational Safety (6.3.6)
- Procedures and Training Program (6.3.7)
- Human Factors (6.3.8)
- Quality Assurance (6.3.9)
- Emergency Preparedness Program (6.3.10)
- Provisions for Decontamination and Decommissioning Program (6.3.11)
- Management, Organization, and Institutional Safety Provisions (6.3.12)

The NNSA has verified the base information in the DSA through walkdowns, document review, operating personnel interviews, and comparison to other nuclear facility authorization basis documents. The chapters conform to the guidance provided by DOE-STD-3009-94 and provide the necessary information to support hazard and accident analyses. As appropriate, this SER corrects errors in the base information for the accident analysis and BASES for TSRs, and imposes Conditions of Approval necessary for NNSA to accept the residual risk.

3.1 Site Summary

The Laboratory and associated residential areas of Los Alamos and White Rock are located in Los Alamos County in north-central New Mexico, approximately 96.6 km (60 mi) north-northeast of Albuquerque and 33.5 km (25 mi) northwest of Santa Fe (Figure 1-1). The Laboratory is located at an altitude ranging between 1,800 m and 2,500 m (6,000 and 8,000 ft) on the eastern slopes of the Jemez Mountains. Since its inception in the 1940s, the Laboratory has grown considerably and has expanded northward. White Rock is located along the White Rock Canyon of the Rio Grande. Both White Rock and the town of Los Alamos are run by Los Alamos County. TA-54, Area G is situated atop Mesita del Buey, a narrow southeast-trending mesa about 3 km (2 mi) long and 0.4 km (0.25 mi) wide. The mesa surface slopes gently from an altitude of about 2,100 m (6,900 ft) near its western margin to about 2,000 m (6,600 ft) near its eastern end.

The two main access routes to Los Alamos are highways and the Los Alamos Airport. There are two highway routes that access Los Alamos. State Road 502 accesses Los Alamos from Pojoaque, Española, and surrounding areas to the southeast of Los Alamos. State Roads 4 and 501 access Los Alamos through the Jemez Mountains from the west and southwest. State Road 502 is the main artery for outside commuters; therefore, it can become quite congested in the morning before work and immediately after work. During off-hours and weekends, neither road would be considered a heavy traffic area. A DOE-owned and controlled roadway (Pajarito Road) to which the public has access passes on the south side of TA-54. Approximately 8,000 automobiles traverse Pajarito Road daily (Environmental Protection Group 1994).

The Los Alamos Airport, located 5.8 km (3.6 mi) north of TA-54, consists of a single east-west runway. Because of local conditions, air traffic typically enters from and exits to the east. The west end of the runway is normally used only for runups or taxiing. There are currently no commercial flights using Los Alamos Airport.

The closest technical areas to TA-54 include TA-51, TA-18, and TA-36. TA-51, located northwest of TA-54 along Pajarito Road, is the Animal Exposure Facility. TA-18, situated across Pajarito Road at the northwest corner of TA-54, is the Pajarito Laboratory Site, where the fundamental behavior of nuclear chain reactions is studied with simple, low-power critical assemblies. TA-36, also located across Pajarito Road, along the western boundaries of TA-54, is the Kappa Site. Various explosives phenomena, such as detonation velocity, are investigated at TA-36 (Environmental Protection Group 1994). The type of activities conducted and the separation distances ensure that these nearby sites will not affect the safety of operations conducted at Area G.

Area G's impact on nearby facilities is mainly limited to road closures that are required during some waste transfers. Accidents at other facilities could result in restricted access to Area G.

Maximum magnitudes for earthquakes, resulting from fault activity are Mw 6 and 7 with return periods of about 2,000 and 10,000 years, respectively. The Performance Category 3 wind for Los Alamos is 117 mph and the seismic peak horizontal loading is .31g with an annual exceedance frequency of 5×10^{-4}. Lightning strike density is estimated to be about 7.8 strikes/km^2-yr.

3.2 Facility Summary

Operations associated with waste management at Area G include radioactive waste receipt, handling, repackaging, storage, container inspection, decontamination, waste characterization and verification (both intrusive and non-intrusive), size and volume reduction, disposal, retrieval of legacy waste, environmental monitoring, and other operations attendant to the management of waste. The area has been in use since 1957 and is expected to remain active through the foreseeable future.

MLLW and TRU are managed according to applicable regulations. Prior to these regulations all waste forms were land-disposed (buried) in pits, retrievably stored below grade, or stored on earth-covered surface pads at this site. RCRA now prohibits this practice, and all new mixed waste received is currently stored within aboveground structures (domes). Retrievably stored TRU wastes at Area G, if acceptable under the WIPP WAC will be prepared for eventual shipment to the WIPP. TRU waste not meeting the WIPP WAC and MLLW with no treatment path will be held in storage until process activities are developed to treat and prepare this waste for acceptance at WIPP.

To accommodate the radioactive disposal and storage needs of the Laboratory, further development of the site is planned. This includes construction of new facilities that will be used to characterize, decontaminate, volume reduce, and store TRU and mixed low-level wastes.

The major structures and facilities include:

- Waste Assay Facility, Building 54-2 which houses the Waste Assay for Nonradioactive Disposal (WAND), High Efficiency Radiation Counters for Ultimate Low Emission Sensitivity (HERCULES), Long Range Alpha Detector (LRAD), and the Low Level Waste Assay System (Q2) projects. It also houses other waste characterization activities, such as those using stand-alone High Purity Germanium (HPG) gamma detectors, and includes a shop area for general maintenance and equipment storage.
- Drum Preparation Facility, Building 54-33, contains a Drum Venting System which is currently not in use.
- Waste Storage Domes, Buildings 54-48, 54-49, 54-153, 54-224, 54-226, 54-229, 54-230, 54-231, 54-232, 54-283, and 54-375. Currently at Area G there are 11 dome buildings that are used for waste storage. Each building is a single-story dome with no internal partitioning. Each dome is set and anchored on an asphalt pad over inactive waste disposal pits with a perimeter curb rim. The perimeter curb minimizes precipitation runoff from washing into the dome floors or outflow from spills.

- Waste Compactor Facility, Building 54-281 is used to house a LLW compactor that exerts 200 tons of force. LLW is transported directly to Area G from other Laboratory facilities, compacted in this building, and buried in one of the Area G waste disposal pits.
- Tritium Monitoring and Storage Sheds, Buildings 54-1027, 54-1028, 54-1030, and 54-1041 are commercially constructed steel sheds located near the southeast side of Buildings 54-49 and provide for storage of tritium-contaminated wastes.
- Sort, Segregation, and Decontamination (SSD) Facility, relocatable. SSD operations will be conducted inside a modular containment structure (Perma-Con® brand) that is currently housed inside Building 54-231. This structure may be used as needed in any of the waste storage domes at Area G for waste repackaging, decontamination, characterization, and verification.
- Currently active LLW disposal pits (54-15, 54-31, 54-38, and 54-39). Disposal pits are used for the shallow land burial of LLW. Ramps are provided on one end of each pit to provide access for waste transporters and heavy equipment. Pit 31 is presently dedicated for the disposal of LLW containing friable asbestos. Pits are constructed on an as needed basis within Area G.
- Shafts at Area G are used for both disposal and retrievable storage. Shafts may contain such waste as radioactive biological waste, PCB and beryllium-contaminated waste, solid LLW with surface dose rates greater than approximately 1 rem per hour, tritiated wastes with activity concentrations greater than 40 curies per cubic m, and remote-handled (RH) TRU waste. There are approximately 260 shafts in Area G.

4.0 HAZARD AND ACCIDENT ANALYSIS

4.1 Basis for Approval

The TA-54 Area G Documented Safety Analysis adequately performed a hazard classification per Section 3.0 of DOE-STD-1027-92 and DOE-STD-3009-94. The residual risk is defined by the DSA, TSRs and this SER (with accompanying Conditions of Approval, revised accident analysis and revised TSRs) and is acceptable to the NNSA.

The hazard analysis identified and evaluated a number of accident scenarios. The evaluation covered the activities performed at TA-54 Area G, using established industry methods, and as appropriate, identified preventive and mitigative features for the spectrum of events examined. When needed, the hazard evaluation and accident analyses resulted in design and operational improvements being identified in Chapter 3 of the DSA.

4.2 Hazards Analysis

The objectives of the hazard analysis are to identify and characterize hazards present throughout the facility, to perform a systematic evaluation of potential accident scenarios that could involve such hazards, and to identify safety controls and qualitatively establish their adequacy. This methodology was used to present a comprehensive evaluation of process-related, natural phenomena, and external hazards that can affect the public, workers, and the environment.

The hazard analysis methodology is based on a graded approach as described in DOE-STD-3009. An important element to the hazard analysis process is establishing the EGs for classifying SC-SSCs. DOE-STD-3009, defines EGs as follows:

> *Hazardous material dose/exposure values that the safety analysis evaluates against. The intention is that theoretical individual doses/exposures exceeding the Evaluation Guidelines should not occur at a given point, unlike other values, such as emergency planning thresholds. Off-site Evaluation Guidelines are established for the purpose of identifying and evaluating safety-class structures, systems, and components. On-site*

Evaluation Guidelines are not required for adequate documentation of a safety basis utilizing the overall process of this Standard.

DOE has issued an off-site EG for radiological releases of 25 rem total effective dose equivalent (TEDE) (DOE-STD-3009, Appendix A). The dose estimates to be compared to it are those received by a hypothetical maximally exposed offsite individual (MEOI) at the site boundary for an exposure duration of 2 hours. This EG is frequency independent.

Worker safety from a radiological criteria perspective is evaluated against several criteria including major contributor to defense in depth, single barrier to acute injury and the potential for significant radiological dose to the worker.

4.2.1 Hazard Identification

The primary objectives of the hazard identification are to identify all the hazards associated with the processes being authorized and the facility in general, to screen standard industrial hazards, and to identify hazards that might present threats to the safety and health of workers or the public or threats to the environment. These hazards include not only radiological and hazardous materials (e.g., toxic chemicals) but also energy sources (e.g., flammable fuels) associated with Area G activities and operations.

Hazard identification selects those operations and processes where hazards other than standard industrial hazards are present that might present a threat to the health and safety of on-site workers or the public. Hazard identification also determines which hazards require more detailed evaluation or analysis based on their potential to cause harm. A team of qualified safety analysts performed the hazard analysis with input from facility and operations personnel. The team consisted of several hazard/safety analysts with backgrounds in nuclear engineering, health physics, mechanical engineering, fire protection engineering, and chemical engineering. Standard Hazard Identification checklists were used to identify the hazards. The TA-54 Area G hazards analysis yielded 131 scenarios that were semi-quantitatively evaluated for consequences to the public, worker, and the environment. Controls were identified for all scenarios and were evaluated as to their effectiveness.

The NNSA found that integration of supplementary analyses in developing the hazards analysis was lacking. DOE Order 420.1 requires that an FHA be developed in conjunction with the DSA/TSRs and integrated into the hazards analysis. The Area G Fire Hazards Analysis conclusions and recommendations were not fully addressed in the DSA/TSRs. Furthermore, the information derived from the FHA is required to be addressed in the DSA, including the adequate disposition of FHA recommendations. Review of the Area G FHA indicates that the FHA was developed in November 2001 and only referenced the 1995 safety basis, and as such is an indicator that the information required updating. Further review of the FHA indicated that the cleanup cost at Area G as a result of an area wide fire was estimated to be "negligible" at $6/ft^2. The FHA did not address cleanup outside the domes nor was any fire hydrant information provided . Also, the recommendations made in the FHA do not appear to have been addressed in the DSA/TSRs. Below are examples of omissions:

1. Storage configurations inside the domes were recommended to be long, narrow rows with the central isle at least twice as wide as the pile height.
2. Domes containing primarily plywood boxes and FRP boxes were recommended to have sprinklers kept in as operational a condition as possible, at least in manual mode.
3. Multiple wooden or FRP boxes were recommended to only be stored in domes equipped with sprinkler systems.

4. Others (not listed here).

Inadequacies in the FHA have resulted in a detailed Condition of Approval.

4.2.2 Hazard Evaluation

Hazard evaluation is the process of identifying events of interest involving the identified hazards, qualitatively determining the unmitigated consequences, estimating the event frequencies, comparing the consequences to threshold values, and identifying the controls needed to prevent such accidents or mitigate their consequences. The objectives of this process are to identify controls that reduce the operational risks, to identify SS-SSCs, and to identify events requiring accident analysis.

The analysis technique used in this hazard analysis was a combination of the hazards checklist, "What-If", and PrHA methods. The hazard evaluation process was used to develop an initial set of accident scenarios based on the hazards present at TA-54 Area G. The completed hazard identification checklists provided a qualitative listing of the hazards by hazard initiating cause group, the location in Area G, and the hazard type. The purpose of the "What-If" analysis was to capture many different types of accidents independent of type or severity of consequences. Accidents of little or no concern (low consequences or standard industrial accidents) were screened out from further evaluation. Operational accident categories included fires, explosions, spills (radiological and/or toxicological), and criticality. Natural phenomena events at the Los Alamos site include earthquakes, high winds, lightning, and precipitation. External events include airplane crashes, nearby transportation accidents, and nearby forest/brush fires.

Systematic application of the hazard evaluation technique to the activities conducted at TA-54 Area G generated a large number of accident scenarios (131), listed individually in Appendix A of the DSA. A risk-ranking matrix was used to screen scenarios into the accident analysis. Risk ranking utilizes both frequency and consequence to rank accidents for further consideration in the accident analysis. The NNSA has concerns with this approach and a condition of approval has been issued herein that requires the Laboratory to employ an approach that follows the guidelines in DOE-STD-3009. Specifically, DOE-STD-3009 clearly indicates that one should not dismiss operational accidents based on frequency, especially those that could challenge the EG. Screening out accidents that could challenge the EG because of risk ranking could lead to missing controls for protection of the public. Table 2 in LANL's <u>own</u> *Operational Support Tool* 300-00-06A states, "1. The matrix should NEVER be the decision maker. A matrix is not sophisticated enough to replace sound engineering logic. Therefore, it is important to recognize that the matrix only provides useful information to LANL/DOE to aid in decision making. 2. Matrices should not be used to determine the safety importance of SSCs (i.e., not to be used to designate Safety-Significant or Safety-Class SSCs). STD-3009 advocates an approach based on engineering logic to make these classifications. 3. Risk matrices should not make statements about <u>acceptable</u> risk. 4. Risk ranking should not circumvent the HA process. In other words, low initial risk is not a valid means to screen out or delete the scenario from the HA."

Additionally, allowing the utilization of risk-based determinations for screening accident scenarios would be contrary to Unreviewed Safety Question (USQ) methodology, which does not allow risk-based determinations. Rather, USQ determinations are based on the increase of consequences and frequency as separate components of accident development. Finally, the acceptance of risk is strictly a NNSA function.

SS-SSCs and TSR Administrative Controls. The facility and process safety features identified by the hazard analysis were reviewed in the context of the significance of their safety function to identify SS SSCs and TSR administrative controls. The criteria identified in DOE-STD-3009 was used for designating SSCs as SS or other controls as TSR administrative controls.

All SSCs identified by the PrHA as candidate SS-SSCs and all administrative controls identified by the PrHA for TSR ACs were evaluated. Table 3-20 in the DSA lists all the candidate controls (all SSCs indicated as "SS" and all administrative controls indicated as "TSR-AC" in the "Prelim Control Cat" column of the PrHA tables). Each control is compared to the criteria and a final categorization derived. This final set of controls was carried forward into the TSRs as discussed in Chapter 5. Additional SS-SSCs and TSR administrative controls may be identified, and SSCs could be upgraded to SC-SSCs in the DSA accident analysis.

Defense in Depth and Worker Safety SSCs. Defense-in-depth and worker safety SSCs and that were identified to be safety significant by the hazard evaluation can be found in Table 3-20 in the DSA and include:

- Metal TRU waste container
- Waste storage dome door restraints (clamshell-type doors)
- Lightning protection system – waste storage domes
- Structural capability of waste storage domes
- Storage configuration for TRU waste containers (locations, use of pallets, drums on pallets banded together, stack height limit)
- Crane and lifting devices used for shaft placement meet load rating for lift
- TRU waste container securing devices or truck railings
- Interlocks prevent operation if test chamber doors in open position
- Chamber shielding
- Shaft covers
- Earth overburden on disposal pits
- Automatic fire suppression system in each tritium waste shed

The hazard evaluation was also used to select the following programmatic administrative controls that require elevation to TSRs:

- "Working Alone" restrictions
- Work performed to approved procedures (activities in waste storage domes or that might affect TRU waste containers)
- Work authorization system (work permits, hot work permits, RWPs)
- Vents installed on TRU waste drums/SWBs
- Electrical equipment in waste storage domes meets NEC or UL requirements (or equivalent)
- Area G Emergency procedures and training
- Availability of emergency response equipment (communications systems and windsocks)

- Mobile facilities (e.g., NDA/NDE mobile trailers, construction trailers, temperature equilibration trailers) sited in accordance with NFPA requirements
- Combustible loading/ ignition control in TRU waste areas (storage and processing areas)
- TRU waste drums are stored on metal pallets or other non-combustible surface
- Vegetation and brush cut back from site perimeter around waste storage domes
- Los Alamos Fire Department response (includes fire hydrants located throughout the site as required to support firefighting activities)
- LLW pit combustible restrictions
- No storage of flammable gases or liquids in TRU waste storage or processing areas
- Designated area for refueling will be established
- TRU waste drums containing more than 300 PE-Ci are overpacked
- Limit on quantity of TRU waste on a truckload
- Limit on inventory in each TRU waste storage facility and each tritium waste storage shed (containers may be stored outside the waste storage domes but they must be stored within approx. 50 ft of the dome and counted in the dome's inventory)
- Limit on TRU waste inventory in or adjacent to (within approx. 50 ft) a mobile facility (NDA/NDE unit or temperature equilibration transport)
- Facility maintenance program (waste storage domes and associated equipment and tritium waste storage sheds)
- Maintenance and inspection program for vehicles and forklifts used for TRU waste container handling and on-site transportation
- Procedures for loading, securing, and transporting TRU waste containers safely
- Shaft placement operations suspended during adverse weather conditions
- TRU waste containers in storage are inspected regularly for corrosion or other degradation and remediated
- Crane legs be set before lifting waste container or component for placement in a shaft
- Crane operating procedures for placing waste container or component in a shaft
- Waste storage dome doors (clamshell type) to be closed in high wind conditions and latched to restraint.
- Tritium waste shed doors to remain closed when operations not in progress
- RCTs survey TRU waste containers during receipt at Area G.
- TRU waste open container controls (containers opened only inside enclosure with filtered ventilation, RCT monitors activity, respirators worn when necessary, only one container open at a time, removal of material from drums limited and controlled)

- NDA/NDE operating procedures and safety devices (interlocks, personnel warning devices, etc.)
- Limit on NDA/NDE source strengths (energy levels)
- Postings, barriers, and warning devices
- Personal protective equipment worn, including respirators when airborne activity could be present
- Job-specific training (procedures, equipment operation, Area G hazards, etc.) for TRU waste operations. Includes training technicians to procedures for securing TRU waste containers to transport vehicles.
- Vehicle driver qualification and crane/forklift operator training and certification for handling/transporting TRU waste containers. Forklift operator training to include minimizing container lift heights
- Vehicle crash barriers placed at strategic locations
- Speed limits on site roadways

As stated earlier, the objectives of this process include identifying events requiring accident analysis. The accident scenarios were selected to ensure that a representative spectrum of accident scenarios involving TRU waste and LLW. Additional scenarios involving tritium waste were also considered to ensure that accident scenarios are representative. Consequence modeling was performed for appropriate scenarios from each category.

Operational Spill – TRU Waste

The analysis covered all TRU waste container operational spill accident scenarios. Because many of these scenarios are very similar, a representative set of cases was defined to cover this accident category.

TRU Waste Transportation Accident and Fire

The analysis covered all accidents involving the transport of TRU waste containers.

TRU Waste Drum Deflagration Accident

The analysis covered TRU waste drum storage scenarios and bounded the consequences of an exothermic chemical reaction.

Waste Storage Dome Fire

The analysis covered the waste storage dome fire scenarios identified above, but excluded fires initiated by a forest/brush fire and by an airplane crash. Waste storage dome fires bounded fires at NDE/NDA mobile facilities and in LLW disposal pits.

Brush/Forest Fire Spreads to Multiple Waste Storage Domes

The analysis covered TRU waste storage fire scenarios in multiple waste storage domes and bounded the consequences of NDE/NDA fire scenario.

Earthquake

The analysis covered TRU waste storage accident scenario caused by earthquake.

Waste Storage Dome Structural Failure from High Wind

The analysis covered TRU waste storage in domes by analyzing a dome door blown off accidentally and bounded a dome collapse accident due to high wind. Also bounded here was high wind accidents during shaft placement operations.

Airplane Crash into Waste Storage Domes

The analysis covered TRU waste storage scenarios caused by an airplane crash.

Fire in Tritium Sheds

The analysis covered fire scenarios in the Tritium Shed

Operational Spill during Shaft Placement

The analysis covered accident scenarios related to placement of material into the Storage and Disposal Shafts.

4.3 Accident Analysis

The accident analyses presented in the TA-54 Area G DSA are reviewed in this section, and evaluated for defensibility, conservatism, and general adherence to accident modeling criteria in DOE-STD-3009-94 Appendix A. With the exceptions noted in this SER, the accident analysis in the TA-54 Area G DSA is thorough and complete. In general, it was found that the analyses was performed within the guidelines in DOE-STD-3009 for calculating a dose value for comparison to Evaluation Guideline (EG) values.

4.3.1 General.

The NNSA performed detailed technical reviews of the Area G analysis including methodologies, models, data, and assumptions used in calculating consequences to the maximally exposed off-site individual (MEOI). This section discusses the approach and application of models and/or computer codes that support the specific phenomenological events needed for evaluating the impacts posed by the accident scenarios.

4.3.2 Review of the TA-54 Area G Accident Analysis.

4.3.2.1 Source Term Analysis.

The TA-54 Area G analysis calculated source terms (ST) utilizing the five-factor formula,

Source Term = MAR x DR x ARF x RF x LPF

which accounts for material-at-risk (MAR), damage ratio (DR), airborne release fraction (ARF), respirable fraction (RF), and leak-path factor (LPF). NNSA reviewed the TA-54 Area G source term derivations and implementation of the five factor formula and data.

Material-at Risk (MAR) and Damage Ratio(DR) Issues. Several iterations of NNSA review, comment and LANL comment resolution has now resulted in substantially more accurate characterization of material-at-risk at TA-54 Area G. Characterization of MAR is still not well understood by the Laboratory. Previous NNSA comments in this regard involve improper exclusion of material at risk in the analysis. In this DSA, the Laboratory failed to include **all** MAR in developing accidents for analysis. Proper treatment of MAR involves use of the appropriate mechanisms within the five factor formula to refine the amount of MAR that actually contributes to the source term. An example of where this misunderstanding of MAR and damage ratio exists is below is from .

The DSA states: "Pits contain on average less than 250 PE-Ci and only 500 PE-Ci is estimated to be uncovered during burial. Pits, therefore, add very minimally in terms of consequences to the analysis. Therefore, the damage ration for shafts and also pits is zero."

The above quote indicates that the damage ratio can be affected by the amount of MAR available. For the purposes of accident analysis, the damage ratio is the amount of available MAR that can be affected by an accident. The damage ratio does not affect amount of material at risk. It can be inferred from the way this section is written, that doses resulting from the accident analyses are so great that any perturbation from MAR in disposal pits or shafts are considered by the Laboratory to be acceptable as a result of the damage ratio is assumed to be zero. The analysis is incorrect in that it allows for changes in MAR that were not adequately analyzed.

Another example of improper MAR utilization in the safety basis is that, in the TSR, there were no LCO material-at-risk limitations for disposal pits or disposal shafts. In this DSA, material at risk limitations on the disposal pits and shafts were deleted (This SER addresses this exclusion in the conditions of approval). The exclusion of MAR is not allowed for any reason. Damage ratio arguments can be made that limit the amount of MAR that can be acted on by a given accident situation. As an example, a vault may be so robust that the damage ratio can be claimed (and technically defended) to be zero, resulting in the MAR not adding to the source term and, ultimately, the consequences. In this example case, the container is a control that would be taken credit for in the DSA. All MAR must be initially identified in the analyses in order that safety controls can be identified.

With the adequate disposition of the SER conditions of approval, incorporation of NNSA revisions to the accident analysis, and revisions to the TSRs, NNSA concurs with the Source Terms characterized in the accident analysis.

4.3.2.2 Exposure Pathway

Airborne release pathways are those of primary interest for nonreactor nuclear facilities. Typically solid plutonium or uranium in metal form does not represent a significant inhalation hazard from dispersal types associated with mechanical or thermal insults.

4.3.2.3 Location of Maximally Exposed Offsite Individual

The closest offsite individual receptor (MEOI) is at the site boundary approximately 250 meters to the north closest TA-54 facilities to the site boundary are Building 226 and Dome 54-33. Land beyond this northern site boundary belongs to San Ildefonso Pueblo. The Laboratory facility closest to Area G is TA-54 Area L to the west. The facility is located approximately 800 m from the town of White Rock, NM and 1600 m from the town of Los Alamos, NM.

4.3.2.4 Model Results

The TA-54 Area G analysis was conducted with the MACCS2 accident analysis computer code (Jow et al, 1990). MACCS2 is a flat-terrain, straight-line dispersion model that provides ground-level plume-centerline χ/Q values as a function of distance for all parameterized stability categories and wind speeds. The MACCS2 code outputs several different kinds of air dispersion products that give rise to different types of radiological dose quantities. Depending upon the kind of scenario under consideration, the user specifies desired results by adjusting parameters in the ATMOS and EARLY input files.

The consequences of radionuclide releases under postulated accident conditions were evaluated with Version 1.12 of MACCS2 computer modeling code. Time-integrated, scaled, air concentration (χ/Q in units of s/m^3) were calculated using the Tadmor and Gur analytical fits to the stability-dependent Pasquill-Gifford dispersion-parameter data as amended by Dobbins. These correlations are most applicable in the distance range of 0.5 km to 5.0 km, where much of the site boundary approaches TA-54. The facility had previously tried to use the Karlsruhe/Julick parameters in the dispersion modeling but upon intensive NNSA technical review could not defend its use and applicability at TA-54 Area G with the lower dose consequences.

Dispersion values (χ/Q) reported for the purpose of application to accident analyses were computed using a technique described in Regulatory Position 3 of NUREG 1.145 that is endorsed by NNSA for SAR accident evaluations in DOE-STD-3009, Appendix A. This technique yields a single, representative, site-boundary dose value that is not exceeded more than 5% of the time over which meteorological conditions are sampled. This technique accounts for both wind direction and distance from the release point to the receptor location in each of 16 compass sectors for which wind directions are recorded. A detailed description of the selection method is provided in Appendix 3C of the DSA.

The selection of dispersion values incorporated 6 years of meteorological data spanning the period of 1996 through 2001. The data are recorded at an elevation of 11 meters above ground level at TA-54 meteorology tower. All meteorological data are recorded and archived by the LANL Air Quality Monitoring Group (ESH-17) in single-year data files appropriate for use in the MACCS2 code. Dispersion calculations from multiple years of data were combined according to the NUREG method using a post-processing utility called POSTMAX that was developed for use in conjunction with MACCS2 for the specific purpose of selecting representative site-boundary dilution factors. Software quality assurance records for this program are documented in LA-UR-01-1461, *Software Quality Assurance Verification Report for the Postmax Dispersion Analysis Postprocessor.*

4.3.2.5 Elevated Release Point

All releases were specified to occur at ground level and no momentum was attributed to buoyant plumes. Thus, both spill and fire accident scenarios were modeled as ground level releases. Two non-buoyant plume releases and 18 buoyant plume releases, ranging from 0.10 MW to 25 MW, were modeled. One of the non-buoyant calculations represents a standard 95th percentile χ/Q calculation. The other is a special case providing a 95th percentile χ/Q value based on all wind speeds being artificially defined as the highest hourly wind speed observed at the Area G meteorological tower from 1996 to 2001, 13.4 m/s (30 mph). The NNSA agrees with the ground level release assumptions are conservative because of the facilities and configuration at TA-54 Area G and because the waste storage domes fabric would likely burn through in most of the fire scenarios.

4.3.2.6 Dispersion Parameters

Tadmor and Gur analytic correlations to Pasquill-Gifford dispersion-coefficient data were applied. These correlations have an implicit averaging time of 3 minutes built in to their description of plume growth, and they best describe dispersion over smooth terrain (roughness length equal to 3 cm) within the range of 0.5 to 5 km, which is a close approximation of the TA-54 Area G site boundary.

The single most influential choice of parameters that a safety analyst makes is the set of dispersion coefficients, i.e., the correlations that define lateral and vertical plume growth as functions of downwind distance. Many such correlations are available in literature that is based on experiments conducted in a variety of terrain conditions. A given set of correlations based on a roughness z_0 can be adjusted for a local surface roughness z by the scaling factor $(z/z_0)^{0.2}$, as suggested by the American Meteorological Society. Because the Tadmor and Gur correlations selected for this study are based on data collected over smooth terrain of 3-cm roughness, a roughness correction is appropriate for a facility that is surrounded by conifer forest. A surface roughness scale factor of $(z/z_0)^{0.2} = (38/3)^{0.2} = 1.66$ was used to correct the smooth-terrain vertical dispersion coefficients that are based on a 3-cm roughness to a local surface roughness of 38 cm. The selection of 38 cm as a representative roughness length for LANL facilities was cited in Los Alamos Climatology (Ref. 6), based on wind measurements taken at TA-50. The American Meteorological Society (Ref. 7) has endorsed this formula as a reasonable modification of available experimental data to site-specific conditions. The facility had previously tried to use the Karlsruhe/Julick dispersion parameters in the dispersion modeling but upon intensive NNSA technical review could not defend its use and applicability at TA-54 Area G with the lower dose consequences.

NNSA determined that the use of a surface roughness correction factor of 1.66 for use in the MAACS2 code was appropriate for modeling TA-54 Area G releases and still conservative with respect to actual tree growth surrounding Area G.

4.3.2.7 Plume Meander

Plume meander accounts for movement of the plume centerline due to variation of wind direction (sigma theta), yielding a modest decrease in χ/Q (USNRC, 1981). In MACCS2, plume meander is controlled by a user specified reference time (TIMBAS) and plume release duration (PLUDUR). In the TA-54 Area G analysis, a value of 60s was used for both the reference time and plume release duration. When these two values are equal, plume meander is effectively turned off and MACCS2 model reports an undiluted χ/Q result.

If considered, plume meander can reduce the calculated χ/Q values. The NNSA verified that the Area G analysis suppressed plume meander effects. The approach used in the analysis is therefore judged to be conservative and defensible in this regard.

4.3.2.8 Dry Deposition

For both the Pu-239 and tritium releases, wet deposition was suppressed by specification of MACCS2 input parameters to maintain conservatively high air concentrations. Dry deposition of Pu-239 was allowed with a deposition rate of 1 cm/s. Dry deposition of tritium was not allowed. An NRC sponsored report by Sandia National Laboratories (Ref. 8) recommends parametric dry deposition values for use in MACCS dispersion analyses for risk assessments associated with the operation of nuclear reactors. This study recommends a range of values for particulate dry deposition velocity of 0.03 to 3.0 cm/s. A value of 1 cm/s for dry deposition falls within the more conservative end of the recommended range. NNSA concurs with 1 cm/s dry deposition velocity used in the analysis.

4.3.2.9 Wet Deposition

Wet deposition was not used in modeling plume dispersion at Area G. Wet deposition has the effect of depleting the plume by washing out particulate material through interaction with rainfall during transport. Wet deposition models were suppressed to maintain conservatively high air concentrations under all weather conditions. NNSA concurs with not allowing wet deposition in the analysis.

4.3.2.10 Building Wake Effects

No building wake effects were considered. The initial vertical and horizontal dispersion coefficients were set to the minimum allowed values of $\sigma_y(x=0) = \sigma_z(x=0) = 0.1$ m to approximate a point source, and the building height MACCS2 input parameter was set to 1.0 m. NNSA allows the Laboratory to consider wake effects in MACCS2 calculations when appropriate. The Laboratory chose not to. The NNSA believes this is conservative.

4.3.2.11 Buoyant Plumes

The TA-54 Area G DSA analyzed χ/Q values for multiple buoyant plume releases, ranging from 0.10 MW to 25 MW for each of four release locations within Area G (Dome 54-33, Pad 2, Dome 54-232, and the tritium sheds). The results from the DSA Appendix 3C are restated in Table 1 below.

Table 1. Area G Site Boundary 95th Percentile χ/Q

Accident Scenario	Area G Site Boundary 95th Percentile χ/Q for 1 cm/s Deposition Rate (s/m^3)			
	Dome 54-33	Pad 2 (Adjacent to Dome 54-48)	Dome 54-232	Tritium Sheds
Spill Accident – Non-buoyant release	8.19E-04	7.18E-04	4.05E-04	4.16E-04
Spill Accident – High Wind † Non-buoyant release	5.92E-05	N/A	N/A	N/A

	Area G Site Boundary 95th Percentile χ/Q for 1 cm/s Deposition Rate (s/m^3)			
Fire Accident - 0.10 MW buoyant plume	2.81E-04	2.83E-04	2.49E-04	2.24E-04
Fire Accident - 0.25 MW buoyant plume	1.64E-04	1.56E-04	1.51E-04	1.46E-04
Fire Accident - 0.50 MW buoyant plume	1.29E-04	1.16E-04	9.57E-05	9.27E-05
Fire Accident - 1 MW buoyant plume	9.84E-05	8.99E-05	6.53E-05	5.84E-05
Fire Accident - 1.50 MW buoyant plume	7.65E-05	7.12E-05	5.40E-05	4.51E-05
Fire Accident - 2 MW buoyant plume	5.95E-05	5.61E-05	4.34E-05	3.92E-05
Fire Accident - 2.5 MW buoyant plume	4.73E-05	4.45E-05	3.62E-05	3.43E-05
Fire Accident - 3 MW buoyant plume	3.73E-05	3.46E-05	3.08E-05	3.03E-05
Fire Accident - 4 MW buoyant plume	3.00E-05	2.80E-05	2.35E-05	2.44E-05
Fire Accident - 5 MW buoyant plume	2.56E-05	2.26E-05	1.95E-05	2.04E-05
Fire Accident - 10 MW buoyant plume	1.36E-05	1.24E-05	1.13E-05	1.19E-05
Fire Accident - 25 MW buoyant plume	5.99E-06	5.84E-06	5.72E-06	5.95E-06

As can be seen in the table, the use buoyant plume rise as the result of fires has the effect of reducing the χ/Q values. Independent modeling by the NNSA indicates that the LANL χ/Q values (in the table above) are slightly lower than NNSA values by approximately 5% and are therefore conservative.

4.3.2.12 MEOI Dose Consequences (Maximum Unmitigated Offsite Doses)

The TA-54 Area G analysis calculated generic doses to the MEOI by first calculating a dose-to-source-term ratio using the following formula

$$\text{Ratio} = (\text{unit source term}) \times (\text{DCF}) \times (\text{breathing rate}) \times (\chi/Q_{95\%})$$

Where;

Ratio = rem/PE-Ci,
Unit source term = 1 PE-Ci,
Dose conversion factor (DCF) = 3.08E8 rem/Ci for Pu-239,
Breathing rate = 3.33E-04 m^3/sec, taken from ICRP-26, and $\chi/Q_{95\%}$ = plume-

centerline dilution factor, s/m^3, derived from POSTMAX calculations.

The DSA then evaluated the doses based on the specific accidents being evaluated in the accident analysis.

For material releases:
Dose (rem) = Source Term (gram PE-Ci) x $\chi/Q_{95\%}$ x BR (m^3/s) x DCF (rem/gram PE-Ci)
For tritium:
Dose (rem) = Release (gram) × Oxide Fraction × SA (Ci/gram) × χ/Q (s/m^3) × BR (m^3/s)

SA is the specific activity (9619 Ci/gm for tritium) and BR is the breathing rate for a moderately active human and has a value of 3.5E-4 m^3/s. The DCF is the dose conversion factor for tritium and has the value of 95 rem/Ci, which not only accounts for direct exposure of tritium but also for tritium absorption through the skin.

Table 2. Revised Accident Analysis Summary (Unmitigated Offsite Doses)**

Accident Scenario	Material At Risk (PECI)	Damage Ratio	Airborne Release Fraction	Respirable Fraction	Leak Path Factor	Source Term (PE-Ci)	Dose to MEOI (Rem)
Operational Spill-TRU Waste	22000	1.0	1E-3	0.3	1	6.6	554
TRU Waste Transportation Accident and Fire	1100	1.0	1E-3 (expelled) 0.01 (uncontained burn)	0.3 1.0	1.0	11.33	192
TRU Waste Drum Deflagration Accident	1100	1.0	5E-4 (in drum) 1E-3 (ejected in air) 1E-2 (burns on ground)	1.0 3E-1 1.0	1.0	4.14	139
Waste Storage Dome Fire*	50000	0.695 (lid-loss)	1E-2 (ejected by lid-loss)	1.0	1.0	132.7	622 (Case 2)
			1E-3 (lid loss shock/vibration)	0.3			
		0.305 (seal failure)	5E-4 (in drum, seal failure)	1.0			
Brush/Forest Fire Spreads to Multiple Waste Storage Domes*	50000	1.0	5E-4 (combustibles w/ seal failure)	1.0	1.0	30.1	352 (Case 2)
			6E-3 (non-comb, w/ seal failure)	0.1			
			0.00 (cemented)	1.0			

Accident Scenario	Material At Risk (PECI)	Damage Ratio	Airborne Release Fraction	Respirable Fraction	Leak Path Factor	Source Term (PE-Ci)	Dose to MEOI (Rem)
Earthquake (0.31 g)*	150000	1.0	1E-2 (shock/vib from seismic stress/toppling) 1E-2 (burn uncontained combustible waste) 6E-3 (heating non-combustible in ambient atmosphere)	0.2 1.0 0.01	1.0	879	919 (Case 1b)
Waste Storage Dome Structural Failure from High Wind*	50000	1.0	1E-3	0.3	1.0	15	78.8 (Case 2)
Airplane Crash into Waste Storage Domes*	50000	1.0	1E-2 (shock/vibration) 1E-2 (uncontained combustible waste)	0.2 1.0	1.0	84	1795 (Case 3)
Fire in Tritium Waste Sheds	2 x 10^6	1.0	1.0	1.0	1.0		0.76
Operational Spill during Shaft Placement	1100	1.0	0.001	0.3	1.0	0.33	27.6

*NNSA calculations reveal published doses may be 20% higher based on non-conservative assumptions in analysis.
**Results listed are from worst cases evaluated in the DSA from an offsite dose consequence standpoint

Table 2 summarizes the source term and consequences for each of the evaluation basis accidents in the DSA. The analysis shows that most EBA accidents result in doses to the maximally exposed off-site individual (at the site boundary) that are well above the DOE Evaluation Guideline of 25 Rem. For the purposes of evaluating the off-site doses against the DOE Evaluation Guideline, the NNSA concurs that the accident analysis is conservative and defensible. However, the NNSA has encountered significant issues requiring different corrective actions. These are summarized below:

- This section 3.4.1.1/Table 3-21/Footnote states "There is no limit for cemented or vitrified waste at these locations because of its minimal dispersibility." The underestimation of the fragmentation and dispersibility of cemented TRU waste and the use of an incorrect coefficient for this phenomenon was a comment in the previous submittal (#16) and an NNSA considers the resolution provided to be unsatisfactory. Statements that this material can be stored with no limit due to its' minimal dispersibility, the application of a coefficient that grossly underestimates the fragmentation of aggregates, and the high inventory allowed due to the lack of dispersibility of radioactive material in this form must all be corrected to reflect the true behavior of the material.

  The fragmentation of this material (cement and vitrified waste, although no vitrified waste is cited in this document) is a function of the Energy Density inserted into the material. (Reference NNSA comment #7)

- In section 3.4.1.1/Table 3-22/1st, 5th, & 6th items, the RF cited for the shock-vibration release of surface-contaminated combustibles & non-combustibles is 0.1. The application of this value for LANL safety documentation was cited in the LASO's comments on the previous version of this DSA and the use of the LANL-LASO agreement for the use of a RF 0.3. Multiple NNSA comments were ignored in this regard. Cite correct value in this table and ensure that subsequent calculation and text do not propagate the incorrect value cited here. (Reference NNSA comment #8)

- In Section 4.3.2.4 (Waste Storage Dome Fire), the analysis has significant flaws for the following reasons:

  Eight cases are designated but none is designated as the Evaluation Basis Accident (EBA). Case 8 (sufficient wood crates to affect entire drum array with a 100-gal liquid pool fire) postulates the maximum consequences but does not assess the airborne release from the shock-vibration of materials ejected from the drums resulting from internal pressurization in the "lid loss" response.

  The ARF & RF values cited in Table 3-32/pg. 3-168 and Table 3-33/pg. 3-170 do not include the airborne release from the shock-vibration of materials ejected from the drums resulting from internal pressurization in the "lid loss" response. Thus, all source terms (except for cases 1, 7 & 8) and doses (Table 3-34/pg. 3-171) are underestimated. The above values for case 8 may be as much as ~15% underestimated. (Reference NNSA comment #10)

- In section 3.4.2.5.1 , it is stated
  "Examination of the results of the dome fire analysis (Table 3-34 in Section 3.4.2.4) shows that the worst-case fire with respect to off-site consequences in Case 4, a fire that involves two wood crates and the drums immediately surrounding these crates. This case results in a higher dose than cases that involve more crates and drums because the fire is small enough not to breach the dome fabric. The release for Case 4 was modeled as a non-buoyant release, while the release for large fires that breach the dome fabric (Cases 5 and 6) were modeled with a buoyant plume. Note large fires that breach the dome fabric (Cases 5 and 6) were modeled with a buoyant plume. Note that the ST for all of these cases are about the same, a result of the conservative assumption that all the drums surrounding the burning crates contain the maximum quantity of 300 PE-Ci.

  As notes above, the mechanism for a forest/range fire to spread to the waste storage domes is for burning embers to fall through the dome fabric and ignite combustible material inside the domes. Thus, the dome fabric will be breached and the release will be a buoyant release. The fire in each dome will be approximated by a fire similar to Case 4 in the waste storage dome fire analysis, which models the burning of two wood crates within the drum storage array. However, the dose consequence will be based on a buoyant release, conservatively ignoring any additive effect of fires in adjacent domes on the release plume buoyancy."

  Given uncertainty in potential dome fires resulting from brush or forest fires, limiting the fire impact due to erroneous assumptions concerning bounding consequences derived from an analysis of fires originating inside the dome, has led to a substantial under prediction of the consequences. For example, multiple small fires may be postulated as resulting from embers burning through various points in the dome. Also, large fires may result which greatly exceed the consequences from the postulated scenarios. (Reference NNSA comment #12)

- In section 3.4.2.6.1, the analysis presented does not designate nor present the Evaluation Basis Accident for this scenario. The scenario presented states that, for a bounding unmitigated event, the following conditions may exist:

- TRU waste is stored in drums on metal pallets;
- Drums may be degraded by long-term (>10-yr);
- Drums stored on the top tier (2- to 3-pallets high) can topple if un-banded and ⅔ of 55-gal drum and ⅓ of the over-pack drums breach on impact;
- The distribution of waste in the domes is as cited in Table 3-10/pg.3-36 and their fraction, by activity are:

B. 55-gal - drums21% surface-contaminated combustibles ©, 67.1% surface-contaminated dispersible non-combustibles (D/non-C), and 11.9% incorporated into various matrices such as cement termed non-dispersible non-combustible (non-D/non-C);
C. Over-pack – 22% combustible, 58.8% D/non-C, and 18.4% non-D/non-C

1. Damage to the structure may initiate a fire in one dome;

   Three classes of situations are analyzed:
   1. Case 1 – 3 subclasses addressing the response of regular and degraded un-banded drum to falling from the top tier of drums (Case 1b – drums not banded, degraded, all fail on impact is closest approach to a EBA);
   2. Case 2 – 3 subclasses addressing the response of regular and degraded banded drums to falling from the top-tier;
   3. Case 3 – banded and un-banded drum behavior in a fire assuming the maximum inventory dome;

Case 3 scenarios assume that, unlike Case 1b, only 0.67 of the drums breach on impact, the DR is assumed to be 0.221 vice 0.33 in Case 1b. It is further assumed that only 25% of the material in the drums spills resulting in a composite [ARF][RF] of 2.9E-3 and only the airborne release from shock-vibration for the D/non-c is calculated. Thus, the source term/dose from the fire scenario are not additive to Case 1b since these cases are based on different assumptions.

Independent NNSA calculations indicate that the dose may be somewhat greater for the EBA Earthquake (0.31-g).

Secondly, "The analysis of the drum storage configuration in Appendix 3D indicates that unbanded drums on the third level will likely topple from a 0.31 g earthquake, but banded drums (four on a pallet) will not. Both cases, banded drums and unbanded drums, will be examined in this analysis. As discussed in the previous paragraph, this analysis will assume that second-level drums will not be breached if they fall onto the ground. Thus, it is not necessary to predict the response of the second level of a stack, banded or unbanded."

Data from the Loma Prieta earthquake has demonstrated the potential for collapse of fire protection systems within a structure without substantial deformation of the structure itself. Therefore, collapse of the installed dry pipe sprinkler systems within the relevant storage domes and consequent impact on the drums represents an unevaluated scenario. (Reference NNSA comment #13)

- Section 3.4.2.6.2 states:

"The analysis will assume that only drums (both 55-gal and 85-gal) are susceptible to toppling during an earthquake. Because of their more stable shape, SWBs, wood crates, and large metal boxes are not likely to topple in a 0.31 g earthquake. Thus the analysis will assume that the earthquake will not topple these types of containers, and they are excluded from the calculations."

While no center of gravity evaluations are presented to justify the above claim, no other rationale is provided to show the seismic stability of these containers. The exclusion of the SWBs, wood crates and large metal boxes from dose calculations without a valid engineering argument is not acceptable. Given the recent occurrence FRP box failure at Area G, it is not unreasonable to believe that these wood containers could fail at seismic levels below PC-3, without toppling. Therefore, excluding these containers from the calculations is not conservative and LANL is potentially missing controls for safety. (Reference NNSA comment #14)

- Of the assumptions made in deriving a damage ratio for the earthquake scenario, the following assumption is made:

  "Overpacks (85-gal drums) are stored 4 to a pallet stacked 2-high. (These may be stacked 3-high, but currently are mostly stacked 2-high.)"

  This assumption is carried forward into the TSRs section 5.6.8 (Hazardous Material and Waste Management), where it is stated that:

  "3. Defined storage configuration:

  a. Metal TRU waste drums only stacked to three high."

  A basic premise of accident analysis (or any analysis) is that the assumptions made must be preserved in order for the analysis to remain valid. The above is a case where the analysis is based on a stacking drums 2 high; yet, the parenthetical indicates that they may be stacked 3-high. The NNSA will require that assumptions made in the hazards or accident analyses be preserved and documented as controls.

  Additionally, section 3.4.2.4.1 states:

  "Only drums on the top layer of a drum stack are susceptible to lid loss consistent with the assumption that the lid of a drum having another drum stacked on it will be held down by the weight of the overlying drum."

  These assumptions result in at most one-third of the drums being susceptible to lid loss given a fire. If the 55-gallon drums were assumed to be stacked only two high as is the case in the seismic scenario for over-packed drums, a larger source term would result. While this assumption of drums only stacked three high may be a typical facility configuration, it is not protected by the TSRs. (Reference NNSA comment #15)

- In 3.4.2.8 (Aircraft Crash), although it is stated that a bounding un-mitigated analysis is to be performed, it is questionable that a $DBA_{Aircraft}$ has been postulated or analyzed. Independent calculations indicate that higher doses may be possible vice the highest dose calculated in this section of 1795 rem. (Reference NNSA comment #17)

The above issues indicated that the Laboratory has not yet fully met NNSA expectations regarding conservative accident analysis modeling. The NNSA has performed no fewer than five reviews of the DSA in three years and many of the same issues continue to plague the analyses. This leads the NNSA to the conclusion that it would be necessary for the NNSA to correct for those deficient areas of the DSA Accident Analysis to ensure that it meets NNSA expectations for being conservative and defensible.

NNSA review and evaluation of these accident scenarios indicates that as a result of using non-conservative values for the parameters in the consequence calculations the calculated doses may be a much as 20% higher than what is presented in the DSA. NNSA reviewed the analyses to evaluate the appropriateness of the assumptions, to ensure that appropriate type, level, and number of controls were identified. The consequence analysis even without a potential 20% increase are seen to produce offsite doses to the MEOI that are significantly above the DOE Evaluation Guideline of 25 Rem thereby necessitating the identification of safety class controls to attempt to reduce the doses to below the EG.

Of the ten (10) scenarios screened into the accident analysis, the largest dose to the MEOI is the result of an aircraft crash into the waste storage domes. The maximum dose calculated by LANL of 1795 Rem. NNSA review of the calculations for this accident as well as for the Waste Storage Dome Fire (3.4.2.4), Brush/Forest Fire Spreads to Multiple Waste Storage Domes (3.4.2.5), Earthquake (3.4.2.6), and Waste Storage Dome Structural Failure from High Wind (3.4.2.7) showed that non-conservative estimates were used for a number of the parameters in the consequence calculations. NNSA determined that use of conservative values for the various parameters, such as MAR, damage ratio, airborne release fractions (ARF) and respirable fractions (RF) indicates the calculated doses may be as much as 20% greater than what was presented in the DSA as submitted. NNSA identified a number of discrepancies in the accident calculations in the DSA as submitted. These included but were not limited to incorrect calculation of the damage ratio, lack of consideration for release mechanisms (failed to consider ARF/RF for shock-vibration), non-conservative values for material at risk (MAR). The accident analyses presented, did however, include a number of conservative assumptions, specifically the dose to source ratio for fire scenarios. The dose to source ratio value used in the accident analysis for the fire scenarios was that for a 0.1 MW fire (28.8 Rem/Pe-Ci). The use of the lower energy fire to calculate the dose to source ratio is conservative since the lower energy fire results in higher airborne concentrations to both onsite and offsite MEOIs since the "modeled" plume of contaminants is limited to essentially a ground-level release. NNSA's evaluation of the accident analyses shows that judiciously using conservative values for the parameters would lead to consequences being about 20% higher.

Safety-class controls have been identified because of the calculated high doses. NNSA has determined that recalculation of the accident scenarios and the consequences would not lead to the identification of new or different Safety-Class controls, other than those already identified by LANL or in this SER.

The following table provides a summary of the TSR safety significant controls that are derived in the accident analysis in the DSA. This list was generated by the NNSA to summarize those important controls and it is NNSA's understanding of the safety class, safety significant and administrative controls that were derived from the accident analysis.

Table 3. Safety Class and Other Controls Derived From Accident Analysis

	Operational Spill - TRU waste	TRU waste Transport Accident and Fire	TRU waste Drum Deflagration Accident	Waste Storage Dome Fire	Brush/Forest Fires Affecting Multiple Domes	Earthquake (0.31g)	Waste Storage Dome Structur-al Failure from High Wind	Airplane Crash into Waste Storage Domes	Fire in Tritium Sheds	Opera-tional Spill during Shaft Emplace-ment
Controls Designated Safety Class										
Metal TRU Waste Containers	X	X	X	X	X	X	X	X		X
Banding for Drums on Pallets	X					X				
Dome Structure						X				
Waste Storage Dome Door Restraints							X			
Controls Designated Safety Significant										
[illegible]				X						
SSCs Designated Design Features										
TRU Waste Storage Container	X	X	X	X	X	X	X	X		X
Banding for Drums on Pallets	X					X				
Waste Storage Dome Door Restraints						X				
Waste Storage Domes							X			
Storage Shaft Covers*			X		X	X		X		
Disposal Pit Overburden*	X	X	X			X	X	X		
Vehicle Crash Barriers*	X	X		X						
Sealand Containers*	X	X		X	X	X	X	X		

	Operational Spill - TRU waste	TRU waste Transport Accident and Fire	TRU waste Drum Deflagration Accident	Waste Storage Dome Fire	Brush/Forest Fires Affecting Multiple Domes	Earthquake (0.31g)	Waste Storage Dome Structur-al Failure from High Wind	Airplane Crash into Waste Storage Domes	Fire in Tritium Sheds	Opera-tional Spill during Shaft Emplace-ment
Administrative Controls										
MAR TSR AC										
• MAR Limit 1100 Pe-Ci/truck	X	X								
• MAR Limit 1100Pe-Ci/container	X		X							X
• MAR Limit 25,000 or 50,000 as shown Table 3-21				X	X	X	X	X		
• TRU Waste Containers Over 300 Pe-Ci are Overpacked	X		X							X

	Operational Spill - TRU waste	TRU waste Transport Accident and Fire	TRU waste Drum Deflagration Accident	Waste Storage Dome Fire	Brush/Forest Fires Affecting Multiple Domes	Earthquake (0.31g)	Waste Storage Dome Structur-al Failure from High Wind	Airplane Crash into Waste Storage Domes	Fire in Tritium Sheds	Opera-tional Spill during Shaft Emplace-ment
• Limit total MAR to 150,000 Pe-Ci						X				
• MAR in Tritium Sheds is 10^6 Ci per shed									X	
• Removal of MAR by processing waste container to the WIPP (planned improvement)				X	X	X		X		
Storage Configuration	X					X				
Procedures for loading, securing and transporting TRU waste Containers	X	X								
Vented TRU Waste Containers			X							
TRU waste containers showing corrosion/wear/damage are overpacked	X		X							
Vehicle safety program	X	X								
Qualification of Vehicle Drivers	X	X		X						
Certification of Forklift Drivers and Crane Operators	X	X		X						X
Combustible Loading Program				X	X	X				
Crate Storage Position 6 ft. from TRU waste drums/containers				X	X	X				
Flammable gases/liquids not stored in TRU waste storage area				X	X	X				
Use of Wood Pallets for storing drums containing TRU waste prohibited				X	X	X				
Manual Fire Extinguishers located throughout Area G facilities				X	X	X				
Vehicle and Forklift maintenance and inspection program				X						
Refueling at designated areas only				X						
Place wood crates into metal containers (DVRS) Planned Improvement				X	X	X		X		

	Operational Spill – TRU waste	TRU waste Transport Accident and Fire	TRU waste Drum Deflagration Accident	Waste Storage Dome Fire	Brush/Forest Fires Affecting Multiple Domes	Earthquake (0.31g)	Waste Storage Dome Structur-al Failure from High Wind	Airplane Crash into Waste Storage Domes	Fire in Tritium Sheds	Opera-tional Spill during Shaft Emplace-ment
Removal and segregation of crate waste containers into a single common location with greater capability of handling combustible waste containers (planned improvement)				X	X	X				
Vegetation and brush cut back from site perimeter around waste storage domes					X					
Clamshell Doors to be closed and secured during high wind conditions							X			
General site housekeeping							X			
Crane and Lifting Devices used for shaft placement meet load rating for lift										X

* Designated as Design Features by NNSA in this SER.

Summary Evaluation of Accident Analysis. Because of the nature of operations at TA-54 Area G, the resultant risks, and the effectiveness of proposed controls approved in this SER, NNSA views the long term reduction of MAR as the most effective method of reducing the off-site consequences to the public. The NNSA program, Quick-to-WIPP, entails moving 2000 drums of TRU waste materials from Area G to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, NM by September 2004. NNSA has performed independent calculations to show that TRU waste material-at-risk at Area G could be reduced by up to 70% by the QTW project. NNSA regards this as the most viable way to decrease the nuclear safety risks at Area G. In order to sustain these gains in nuclear safety, the NNSA will require that the facility submit a plan to implement a step-down method to reduce the LCO MAR limitation in the TSRs following removal of the TRU waste material to WIPP. This is to ensure that MAR is continuously reduced and as a result calculated off-site consequences such as those currently analyzed in the DSA will be significantly reduced over time.

With the understanding that the calculated doses in accident analysis could be as much as 20% higher as a result of corrections in the damage ratios, appropriate consideration for the MAR, and the ARF/RF factors for additional release mechanisms, NNSA believes the accident analysis are reasonably defensible and conservative.

5.0 SAFETY STRUCTURES, SYSTEMS, AND COMPONENTS

The DSA (Chapter 4) provides the final designation of design feature, safety-class SSCs, safety-significant SSCs, safety limits, limiting control settings, limiting conditions for operations and administrative controls and their associated functions, functional requirements, and system evaluations. The safety functions for the four SC SSCs and single safety-significant SSCs are clearly defined and are consistent with the bases derived in the hazard analyses. Descriptions in the DSA provide an adequate level of detail for describing intended safety functions or performance. The functional requirements for SSCs provide adequate parameters and limits to ensure that the safety function is fulfilled. The bases for controls are clearly derived relative to the hazard and accident analyses thereby ensuring that the TSRs are written in a manner that is adequate to implement safety at TA-54 Area G.

Additional Safety Significant SSCs and Limiting Conditions of Operations

The additional controls imposed upon Area G operations based upon the results of the NNSA accident analysis review include: designation of the SeaLand containers (or equivalent), shaft covers, disposal pit overburden and vehicle crash barriers as TSR Design Features. Additionally, the LCO 3.1 is modified to include the disposal pits and disposal shaft material limitations and included in the revised TSRs, Attachment 1. In the longer term, LANL shall develop and implement a step-down method of reducing MAR limitations in the LCO. This is to preserve the gains in safety seen from the reduction in MAR at Area G as a result of the transfer of TRU waste to the Waste Isolation Pilot Plant.

The following SSCs were identified in Chapter 3 as being the most important to safety. Their safety functions contribute to preventing or mitigating the limiting accident scenarios evaluated in the accident analysis, or by providing critical defense-in-depth, or by providing for worker safety in potentially life-threatening or disabling situations:

Transuranic (TRU) waste containers. The safety functions that the metal TRU waste containers perform to are:

- Provide primary confinement for readily dispersible TRU waste material;
- Mitigate releases of TRU waste material subjected to mechanical or thermal stresses from postulated accidents; and
- Prevent accumulation of flammable gases inside the waste containers.

The metal TRU waste containers are safety class SSCs based on their requirement to perform the above the safety functions for the accidents postulated in the DSA. Specifically, metal TRU waste containers have been designated safety class based on nine of ten evaluation basis accidents and the postulated consequences. According to the DSA, metal TRU waste containers (drums) comprise over 97% of all waste containers in the inventory and contain over 96% of the inventory in plutonium equivalent curies (PE-Ci). Therefore, the safety functions performed by the TRU waste containers are considered to be of paramount importance. There is concern, however, about the condition (possible degradation) of drums that have been in inventory for an extended number of years. Chapter 4 of the DSA describes that the containers must meet DOT Type 7A requirements as they are initially packed. Surveillance requirements in the TSR for evaluating the metal drums provide a level of assurance that the containers will continue to meet their safety function. In the longer term, the removal of TRU waste drums to the Waste Isolation Pilot Plant appears to be the most effective method to reduce the risk in all Evaluation Basis Accidents by reducing postulated off-site consequences.

It is stated in the DSA, "Most metal TRU waste containers have WIPP-approved filters installed and thus meet the performance criteria. Installed vents and ventilation pathways are assumed to function unless a visual inspection determines otherwise. Vent functional testing is not performed." There is no method identified for sampling the drums to determine if there is accumulation of gases, to open up drums and to test vent filters. This would seem to be an important aspect of this control. Alternatively, the facility should determine the feasibility of utilizing devices to test the pathway to ensure clear of obstructions.

The NNSA, as a Condition of Approval in this SER, shall require that LANL shall develop a method to test the vent filters, to randomly open up drums and determine if gas is accumulating. Alternatively, LANL shall employ a device to test the pathway, with associated performance criteria.

Banding for drums on pallets. The safety functions that the banding for drums perform are to:

- Provide stability to drums resting on pallets.
- Prevent drums lifted on pallets from falling and spilling.
- Prevent drums from toppling during a seismic event.

The accident analysis has resulted in banding for the metal TRU waste containers being designated a safety class control as it provides necessary stability of TRU waste containers during a seismic accident or an operational spill of TRU waste containers. The NNSA concurs with this designation. However, the derivation of this safety class control is flawed. In the development of the performance criteria for banding for drums, the text in the System Description states, "Bands are made of ¾-inch-wide steel strapping. The bands have a 20-mil thickness. They are procured via these commercial specifications. The average break strength of the bands is 1,750 lbs." No indication is given as to where these values are derived from nor are they related to the conditions that will be seen during seismic or operational spill event. No amplifying information is given to indicate what type of stresses the bands are expected to endure, with appropriate safety margin. It appears that the properties are based on the properties of commercially available banding material. Average strength values are not considered conservative for setting limitations for banding strength. The banding material properties must be clearly identified as the important factors in the banding meeting it's safety function. Assurance that the banding is utilized properly, installed by trained personnel, etc should be part of an administrative control. The Laboratory needs to do a better job of linking the derived controls to their safety function. Based on this, LANL shall provide a formal evaluation for selecting this safety class control and to identify the minimum functional requirements to meet the safety function based on the postulated accident scenario. These changes have been incorporated the revised TSRs, Attachment 1. Additionally, implementing procedures shall include, as a minimum: number of bands, spacing, tensioning, placement, minimum strength values, etc.

Waste storage dome door restraints. The safety functions that the waste storage dome door restraints perform to are:

- prevent a dome door from becoming an airborne missile during high wind conditions and impacting waste containers, causing a breach of containers and an uncontrolled release of radioactive material.

LANL has designated the waste storage dome door restraints as passive design features and are included in the design features portion of the TSR document. As passive design features the restraints are not expected to change or to experience operability degradation over time; however, the restraints undergo a periodic in-service inspection to identify any abnormalities that may develop. In addition, a TSR AC requires that the clamshell doors are to be closed and secured during high wind conditions. The storage dome door restraints must also be capable of withstanding a PC-3 Design Basis Wind (DBW), 117 mph "peak gust" wind per DOE Memorandum, Interim Advisory on Straight Winds and Tornados, dated January 22, 1998. Based on an engineering study which evaluated the loads imposed on the dome door from a 96 mph "peak gust" DBW, a restraint design was developed and installed. The restraints are not designed to withstand the loads on the door from a DBW. This vulnerability was identified in Chapter 4 of the DSA. An identified compensatory measure for this vulnerability is removal of MAR by processing waste containers to WIPP. In this SER, the NNSA makes this a Condition of Approval. Additionally, LANL shall develop and implement a step-down method to reduce LCO MAR limitations for the entire site. Given the lack of safety systems at Area G, removal of MAR is the only way of reducing the potential offsite consequences.

Waste storage domes. The safety functions that the waste storage domes perform to are:

- Maintain its structural integrity during design basis natural phenomena events (earthquake, high wind, and snow and ice), preventing structural failure that could result in mechanical impacts to metal TRU waste containers stored inside the structure.

The TA-54 Area G waste storage domes are designated safety class based on a postulated PC-3 (0.31g) evaluation basis earthquake (EBE) event in the accident analysis. The structural evaluation described in the DSA Appendix 3D found that the domes meet PC-3 seismic criteria. The DSA states "The domes are inherently resistant to seismic loads based on their structural strength, low weight, and high flexibility". The NNSA accepts this evaluation. However, the waste storage domes do not meet PC-3 performance criteria for other accident types. In Chapter 4 of the DSA, it is stated that "*the domes are not capable of withstanding PC-3 wind loads of 177 mph. The vulnerability is accompanied by low risk since the likelihood of the postulated accident is beyond extremely unlikely*". (Note: this SER requires that the PC-3 wind loading identified in the above quote be corrected to 117 mph at the next annual update.) The DSA also states "The Sprung domes are designed to support a 13.8-psf uniform snow load and a 17.3-psf drift snow load. Therefore, the domes are designed to less than PC-2." Clearly, these safety class domes do not meet PC-3 performance criteria for other than seismic events. While the DSA identifies that the compensatory measure is to remove waste containers to WIPP, the NNSA designates this a Condition of Approval. Additionally, LANL shall develop and implement a step-down method to reduce LCO MAR limitations for the entire site. As stated previously, given the lack of safety systems at Area G, removal of MAR is the only way of reducing the potential consequences at this site. The waste storage dome structures have been designated passive design features and are included in the design features portion of the TSR document. In-service inspections are to be performed under the maintenance program which will identify any significant damage to the storage domes (e.g., large fabric tears), in which case appropriate repairs will be initiated. These inspections will ensure that the domes continue to meet their performance criteria. LANL shall also develop and submit a cost benefit vs. risk evaluation of upgrading the waste storage domes to meet PC-3 criteria. This is a Condition of Approval in this SER.

Lightning protection system. The safety function that the lightning protection system performs to are:

- Reduce the frequency of a fire in a storage dome caused by a lightning strike.

The Lightning Protection System at Area G has been designated safety significant. Area G domes use a grounded wire grid supported by telephone poles over the structure. All facilities not equipped with power pole gird system, have air terminals down lead and counterpoise systems. Area G structures are afforded lightning protection using a passive engineered feature that conforms to the requirements of NFPA 870. As a passive engineering design control, the LPS is in TSR Section 6, Design Features. The LPS is subject to routine in-service inspection and maintenance to maintain compliance with the NFPA 780.

Shaft Covers. The safety function that the storage shaft covers performs to are:

- Shield material at risk from external hazards such as fire and lightning strikes and by maintaining confinement.

The NNSA has designated the Area G storage shaft covers as TSR Design Feature based on the safety function of shielding MAR from external hazards at Area G. Because of LANL's difficulties in developing defensible and conservative source terms in the DSA accident analysis, the NNSA has determined that, in order to bound the risk, the shaft covers are to be developed as a Design Feature in the TSRs. The DSA submitted for approval did not include the MAR in the shaft or disposal pits in LCO 3.1. Presumably, this is because the calculated consequences to the worker, public or the environment as a result of an accident in the shaft are insignificant. However, in developing the source terms, LANL provides inadequate justification for utilizing a damage ratio of zero for accidents involving the storage shafts and disposal pits. Therefore, any follow-on conclusions regarding the storage shaft accident consequences are suspect. In order to compensate for this lack of information, the NNSA is declaring the shaft covers and disposal pit overburden as design features and are promulgated as such in the revised TSRs, Attachment 1.

Disposal Pit Overburden. The safety functions that the disposal pit overburden performs to are:

- Shield material at risk from external hazards such as fire and lightning strikes and by maintaining confinement.

The NNSA has designated the Area G disposal pit earth overburden as a TSR Design Feature based on the safety function of shielding MAR from external hazards at Area G. Because of LANL's difficulties in developing defensible and conservative source terms in the DSA accident analysis, the NNSA has determined that, in order to bound the risk, the disposal pit overburden is to be developed as a Design Feature in the TSRs. The DSA submitted for approval did not include the MAR in the shaft or disposal pits in LCO 3.1. Presumably, this is because the calculated consequences to the worker, public or the environment as a result of an accident in the shaft are insignificant. However, in developing the source terms, LANL provides inadequate justification for utilizing a damage ratio of zero for accidents involving the storage shafts and disposal pits. Therefore, any follow-on conclusions regarding the storage shaft accident consequences are suspect. In order to compensate for this lack of information, the NNSA is declaring the shaft covers and disposal pit overburden as design features and are promulgated as such in the revised TSRs, Attachment 1.

Vehicle Crash Barriers (Jersey Barriers). The safety function of the vehicle crash barriers are:

- To provide physical protection to TRU waste containers from mechanical hazards associated with vehicles traveling outside TRU wastes storage domes

The NNSA is designating the vehicle crash barriers as a TSR Design Feature based on the ability of the barriers to mitigate the effects of a vehicular accident and the mechanical impact on the waste storage domes and TRU waste contents. The DSA has already designated this control as defense in depth. Given that the consequences of these accidents bound the consequences of a vehicular accident affecting the drums inside the waste storage domes, that it was not evaluated in the accident analysis is not unreasonable. However, as guidance in DOE-STD-3009 stipulates, safety significant controls should be selected based on safety contribution and those safety controls that are cost effective shall be implemented. The vehicle crash barriers shall be designed, built and strategically positioned per NUREG/CR-6190 to prevent a vehicle from breaching the exterior walls (fabric) of the waste storage domes. As a Design Feature, the barriers will be subject to periodic In-Service Inspection Actions. The Administrative Control that governs use of the vehicle crash barriers is the Vehicle Safety Program identified in Section 5.6.13 in the TSRs. The barriers are a significant component of this TSR AC.

SeaLand Containers. The safety function that the SeaLand Containers perform to are:

- To isolate highly combustible wood boxes and other combustible materials to protect them from ignition and fire sources.

The DSA in Section 2.9.1 states "These wood boxes are being placed in SeaLand containers to protect them from ignition and fire sources. SeaLand containers are robustly constructed of metal. SeaLand containers meet the requirements of ISO 1496-1 Freight Containers – Specification and Testing." The above indicates that the SeaLand containers provide an adequate protection of contents for a scenario that has unmitigated consequences well over the DOE Evaluation Guidelines. Yet they were **not** specifically claimed as a Design Feature or as part of an administrative control program (for implementation of use). The NNSA has made a judgment that these containers are necessary for the storage of wood boxes and crates; items that add to combustible loading in the storage domes. LANL shall ensure that the TSRs include a design feature to protect the container characteristics and an administrative program to ensure their use, possibly the Combustible Loading Program.

6.0 DERIVATION OF TECHNICAL SAFETY REQUIREMENTS

In its review of the TSR definitions, the NNSA noted the definition for SAFE CONFIGURATION was not clear and the definition for IN-SERVICE INSPECTION was not provided. Additionally, the definition for ISOLATE AND PROTECT in the TSR was found to be ambiguous in that it required transfer of a container to an "operation-free" location. An operation-free location, by definition, would exclude operations such as transport, storage, surveillance or any other action necessary to restore an LCO to operable. The NNSA will issue page changes to the TSR as part of this SER to correct this inconsistency.

6.1 Description of SL, LCS and LCO with Surveillance Requirements

There were no Safety Limits or Limiting Control Settings proposed in the TA-54 Area G TSRs.

Limiting Conditions for Operations. In LCO 3.1, no material at risk limitations are listed for the disposal pits or disposal shafts. In this current revision of the DSA, material at risk limitations on the disposal pits and shafts were deleted. They were, however, listed in the February 03, 2003 submittal. Given the inadequate discussion of damage ratio provided, it is necessary to ensure that all the material at risk for the facility is defined in the LCO. **The exclusion of MAR is not allowed for any reason.** Damage ratio arguments can be made that limit the amount of MAR that can be acted on by a given accident situation. However, all MAR must be initially identified in the analyses in order so safety controls can be identified. The NNSA will issue TSR change pages to identify the disposal shaft covers and disposal pit overburden as design features and to include respective MAR limitations.

Additionally, items 6. and 7. in LCO 3.1 (plus others in subsequent sections) excluded cemented or vitrified waste from the inventory limits that was previously stated to be based upon its' non-dispersibility. The assumption was challenged by the NNSA in the aircraft impact scenario. As a result, LANL shall also re-evaluate the exclusion of cemented or vitrified waste from the MAR limits for general TRU waste.

LCO 3.1 stipulated that when the LCO CONDITION was entered into (due to exceeding a MAR limitation), the LCO ACTION was to take 30 days to develop a plan for disposition of the MAR. The completion time of one month to "develop a plan to bring site inventory to within LCO limit" is clearly excessive. Waiting until the LCO violation to occur to develop a corrective action plan is reactive in nature. The development of a contingency plan such as this should be accomplished as a condition of approval of the DSA. The NNSA comment that initially identified this issue was written in response to the February 3, 2003 DSA/TSR submittal. This is another example of an NNSA comment not being addressed.

Another example was found in Actions B.2.2 and C.2.2 which require the facility to "Develop and implement a plan to disposition the WASTE CONTAINER" with a completion time of 2 months. Again, contingency planning is necessary to ensure the plan is in place prior to exceeding the LCO limitations.

The revised TSRs approved by this SER to deleted LCO 3.1 Actions A.5, A.6, B.3., B.4, and LCO 3.2 Actions B.2.2 and C.2.2. Reference to these actions was also deleted from the bases statements. Changes were incorporated into the TSR prior to NNSA issuance of the SER. Additionally, LANL provided safety risk arguments in the base statements for all completion times, as directed by the NNSA.

In LCO 3.2, the format for the LCO was not in accordance with established TSR guidance for development of LCOs. The use of indentions was incorrect for the actions that were intended. The NNSA issued TSR change pages correcting this.

6.2 Administrative Controls

In Chapter 5 of the TSRs (Administrative Controls), second paragraph, it was stated: "*These basis statements are for information only and do not constitute a TSR or part of a TSR.*" The basis statements are an integral part of the TSRs as they summarize the basis for designating TSR controls. The statement above has the effect of negating TSR safety bases statements within the TSR.
DOE G 423.1-1 states:

> "5.2.6 Bases Appendix
>
> This appendix provides summary statements of the reasons for the SLs, LCSs, LCOs, and associated SRs. The bases show how the numeric values, the conditions, the surveillances, and the ACTION statements fulfill the purpose derived from the safety documentation. The primary purposes for describing the bases of each requirement are to ensure future changes to the requirement will not affect its original intent or purpose by invalidating the safety analysis and to aid in understanding why the requirement exists. The bases appendix should reference the more specific detailed safety analyses related to the TSR and the derivation of TSR section of the DSA for other related analyses discussed in the DSA."

Furthermore, the basis is necessary for developing and reviewing potential Unreviewed Safety Questions.

DOE G 424.1-1 states:

> "A change that affects initial conditions, a system response time, or some other parameter that can affect the course of an accident analysis supporting the *bases* of hazard controls must be evaluated to determine whether the change would reduce the margin of safety."

The NNSA has directed a TSR Change Page that deleted this statement.

6.3 Design Features

As stated earlier, the NNSA has designated the Area G storage shaft covers, disposal pit overburden, SeaLand Containers (or equivalent) and vehicle crash barriers as Design Features based on their safety function of shielding MAR from external hazards at Area G. Because of LANL's difficulties in developing defensible and conservative source terms in the DSA accident analysis, the NNSA has determined that, in order to bound the risk, the shaft covers, disposal pit overburden and vehicle crash barriers shall be developed as a Design Features in the TSRs. Additionally, the DSA submitted for approval did not include the MAR in the shaft or disposal pits in LCO 3.1. Presumably, this is because the calculated consequences to the worker, public or the environment as a result of an accident in the shaft are insignificant. However, in developing the source terms, LANL provided inadequate justification for utilizing a damage ratio of zero for accidents involving the storage shafts and disposal pits. Therefore, any follow-on conclusions regarding the storage shaft accident consequences are suspect. In order to compensate for this lack of information, the NNSA is declaring the shaft covers and disposal pit overburden as design features and are promulgated as such in the revised TSRs, Attachment 1.

In Section 6 of the initially submitted TSRs "Design Features", the design feature for the Waste Storage Domes had the following performance criteria:

1. The waste storage domes SHALL withstand a Performance Category PC-3 seismic event (0.31g).

2. The waste storage domes SHALL not be degraded below PC-2 for wind (96 mph "peak gust" wind speed).

3. The waste storage domes SHALL not be degraded below their current ability to maintain snow loads.

As a result of NNSA technical assistance in revising the TSRs, clearer NPH performance criteria for snow loading were included in the Design Features section of the revised TSRs, Attachment 1.

Also noted during a recent review of the PDSA for RLWTF TA-50-250 was the plan to replace the Area G waste storage dome fabric. Annex D to the Functional and Operational Requirements states:

"In the event of a fire-related natural disaster, the fabric covering on several of the TA-54 storage domes provides virtually no fire resistance. The TA-54 Dome Fabric Project will eliminate this deficiency by replacing the fabric on these domes with a fire-resistive fabric, providing increased fire protection for the RSW during high risk fire conditions."

Since the new dome fabric was to have fire-resistive characteristics, it seemed reasonable to identify it as a design feature and take credit for it in the safety basis.

Since the review of the DSA and TSR was accomplished, the NNSA was informed that the TA-54 Dome Fabric Project had been cancelled due to budgetary considerations. However, as part of the Condition of Approval to perform a cost benefit vs. risk evaluation of upgrading the waste storage domes (discussed earlier), LANL shall also evaluate the feasibility of upgrading the dome fabric to enhanced fire resistive fabric. Additionally, as a separate Condition of Approval in this SER, LANL shall clarify the performance criteria regarding snow loading.

7.0 PROGRAMMATIC CONTROLS

The general Laboratory or site safety management programs that apply to TA-18 operations were included as TSR ACs and are listed below.

Unreviewed Safety Question Program, Emergency Preparedness Program, Nuclear Criticality Safety, Program, Radiation Protection Program, Maintenance Program, Quality Assurance Program, Hoisting and Rigging Program, Occurrence Reporting, Training and Qualification, Vehicle Safety Program, Operating Records, Conduct of Operations

8.0 LIST OF AB DOCUMENTS

- Technical Safety Requirements (TSRs) for Los Alamos National Laboratory Technical Area 54 (TA-54) Area G, dated April 9, 2003
- Documented Safety Analysis (DSA) for Los Alamos National Laboratory Technical Area 54 (TA-54) Area G, dated April 9, 2003
- National Nuclear Security Agency (NNSA) Safety Evaluation Report (SER) for the DSA/TSRs for TA-54 Area G, dated November 25, 2003.

Appendix A

NNSA Evaluation of TA-54 Area G DSA/TSRs against the "AB Quality Review Report Summary of Findings and Examinations of Causes of LANL Authorization Basis Deficiencies" (McClure Report)

AB Coverage of Operations:

1. **Identified Deficiency**: Positive USQs do not evaluate the need to modify existing TSRs or add new TSRs to the authorization basis adequately.

   SER/DSA Corrective Action Implementation 1 (AB Coverage of Operations): NNSA has confirmed that all USQs generated subsequent to approval of the 1995 SAR have been incorporated into the new TA-54 Area G DSA.

2. **Identified Deficiency**: Changes addressed in USQs are not incorporated into the SAR on a regular basis.

   SER/DSA Corrective Action Implementation 2 (AB Coverage of Operations): NNSA has confirmed that all USQs generated subsequent to approval of the 1995 SAR have been incorporated into the new TA-54 Area G DSA.

3. **Identified Deficiency**: The USQD implementation needs to incorporate the HA as a reference for new hazards and processes to look for new or revised worker safety controls.

   SER/DSA Corrective Action Implementation 3 (AB Coverage of Operations): The DSA Hazards Analysis evaluates all the hazards at Area G and results in a significantly improved DSA over that previously approved. It comprehensively evaluates all hazards and processes for appropriate safety controls as required by 10CFR830 Subpart B. Future USQD evaluations against this safety basis shall also be required to use the HA (and accident analysis) as bases for making determinations of whether the USQDs are negative or positive.

4. **AB Coverage of Operations Summary Recommendation.** Yearly updates of a new SAR should be used to maintain the AB.

   SER/DSA Corrective Action Implementation 4 (AB Coverage of Operations): The DSA Hazards Analysis evaluates all the hazards at Area G and results in a significantly improved DSA over that previously approved. This SER requires, in Conditions of Approval, that LANL make specific upgrades to the DSA at the first annual update. Subsequent annual updates are to be evaluated by LANL and NNSA to determine the need to update. Obviously, there would be no need to update a safety basis that has not been modified by USQs, AB Amendments, TSR Change Pages or other substantive safety basis changes.

Hazard Identification/Evaluation

1. **Identified Deficiency**. The analysis techniques used, although compatible with standard analysis practices referenced in DOE-STD-3009-94, are overly focused on risk definition. This has resulted in the dismissal of events from further analysis based on uncertain frequency and consequence estimates.

   SER/DSA Corrective Action Implementation 1 (Hazard Identification/Evaluation): The NNSA has also found this to be an issue with initial submittals of the TA-54 Area G DSA. NNSA has again commented in this SER that risk definition and risk ranking are not to be used for screening out accidents from further analysis. In response to NNSA comments in this regard, LANL has modified their approach to ensure that accident scenarios that result in consequences affecting the worker, environment or the public are not screened out based on frequency. This change resulted in 13 additional accident scenarios being screened into the accident analysis. The NNSA believes the DSA corrects the identified deficiency.

2. **Identified Deficiency.** There are inconsistencies between the Area G HA and its use in the Area G SAR, particularly in terms of accident selection. The exclusion of fire as an accident in the SAR is incorrect because DOE-STD-3009-94 specifically requests an examination of all major accident types unless the consequences are clearly trivial. We understand that this deficiency is being addressed in the SAR upgrade project.

   SER/DSA Corrective Action Implementation 2 (Hazard Identification/Evaluation): The TA-54 Area G DSA HA comprehensively evaluates all hazards and consequences postulated at Area G, as required by DOE-STD-3009, a safe harbor under 10CFR830. The NNSA has confirmed that the Evaluation Basis Accidents evaluated in the DSA are comprised of all major accident types and are the bounding accidents for TA-54 Area G.

3. **Identified Deficiency.** The hazard evaluations do not systematically and comprehensively identify preventive and imitative SSCs and programs on a hazard/operation-specific basis.

   SER/DSA Corrective Action Implementation 3 (Hazard Identification/Evaluation): NNSA has confirmed that the TA-54 Hazards Analysis systematically and comprehensively identifies preventive and imitative SSCs and a hazard/operations/facility specific basis.

4. **Identified Deficiency.** The definition of facility safety through appropriate summation of the hazard evaluation into integrated discussions of defense in depth and worker safety is incomplete (e.g., fire, lack of identifying compaction as a worker safety concern).

   SER/DSA Corrective Action Implementation 4 (Hazard Identification/Evaluation): NNSA has confirmed that the hazards analysis has considered hazards to the worker and has resulted in safety significant and defense in depth controls being credited in the DSA. Specifically for the Area G Compactor Facility, the NNSA has also confirmed that accidents that impact worker safety have been considered and controls proposed.

Recommendations.

- In future evaluations or SARs, the screening of events based on frequency or off-site consequences should not be used in lieu of improvements where practical or in lieu of a definition of defense in depth and worker safety controls.

  SER/DSA Recommendation Implementation 1 (Hazard Identification/Evaluation): The TA-54 Area G DSA includes a rigorous hazards analysis that identifies safety significant and defense in depth controls for the public, the worker and the environment. The NNSA was not able to identify any instance where accident frequency or consequence has led to improper screening out of accidents for the purpose (or as a consequence) of not naming safety significant or defense in depth controls. The NNSA has reviewed the HA in a rigorous manner and evaluated the screening of accidents with regard to offsite, public and environmental consequences only. Based on this, the NNSA concludes that this recommendation has been addressed in the DSA approved herein.

- Future HAs should focus on identifying preventive and mitigative controls for potential accidents and on assessing whether improvements in design or operating practice can be made regardless of risk categorization based on uncertain frequency estimates.

  SER/DSA Recommendation Implementation 2 (Hazard Identification/Evaluation): This Area G DSA Hazards Analysis includes evaluation of preventive and mitigative controls for potential accidents. The NNSA has rigorously opposed the use of risk categorization for the purposes of screening out accidents from further analysis based on uncertain frequency estimates. NNSA comments from the previous 100% submittal of the DSA/TSRs (which were not-approved) addressed this and were, in part, the basis for not being approved. The facility corrected this improper screening process by ensuring that accident scenarios with the potential to challenge the evaluation guidelines were not excluded from the accident analysis, regardless of frequency. This resulted in an additional thirteen (13) scenarios that were screened into the accident analysis. The NNSA now concurs that LANL has met this recommendation in the TA-54 Area G DSA.

- Future upgrade efforts should provide an integrated development of defense-in-depth and worker safety definitions, augmented by specific clarifications from the accident analysis.

  SER/DSA Recommendation Implementation 3 (Hazard Identification/Evaluation): The TA-54 Area G DSA HA comprehensively evaluates all hazards and consequences postulated at Area G, as required by DOE-STD-3009, a safe harbor under 10CFR830. The NNSA has confirmed that the Evaluation Basis Accidents evaluated in the DSA are comprised of all major accident types and are the bounding accidents for TA-54 Area G. As a result of performing a rigorous hazards analysis, LANL was able to develop defense in depth and worker safety controls in a credible fashion. The NNSA believes LANL has addresses this recommendation in the DSA.

Accident Analysis

1. **Identified Deficiency.** The accident analyses do not cover all generic types of releases as requested in DOE-STD-3009-94. For example, Area G is clearly deficient in terms of fire assessment, whereas for TWISP, it has not documented threat design-basis seismic events cannot produce a release within the intact domes. Also, the TWISP SAR has neglected certain scenarios in the HA, such as the crane impacting an array, and has provided inadequate explanation. As noted in Sec. 4.2, Hazard Identification/Evaluation, accident selection should not screen out significant-consequence, internally initiated events based on scenario frequency.

   SER/DSA Corrective Action Implementation 1 (Accident Analysis): The DSA documents the development of fire scenarios for the accident analysis. The analysis includes parametric evaluation of fire scenarios, varying fire size to determine the consequences and making engineering judgments about whether the dome fabric is breached at each level of fire intensity. The crane accidents have also been developed in the HA as recommended. Therefore, the NNSA has determined that this deficiency has been addressed by the DSA approved herein.

2. **Identified Deficiency.** The release assumptions and parameters used in the accident analysis are not developed consistently and explained clearly. Many are potentially questionable, casting doubt on the conclusion that no doses in excess of 25 rem are attainable.

   SER/DSA Corrective Action Implementation 2 (Accident Analysis): The NNSA has confirmed that the DSA Accident Analysis has provided sufficient detail to understand the parameters used in modeling the release of radioactive material from TA-54 Area G. The important parameters are re-iterated in this SER. The offsite doses for EBAs, as a result of the accident analysis in this DSA with NNSA revisions, are substantially increased over that reported in the 1995 SAR (where

12 rem was the maximum calculated dose) and now requires designation of safety class controls. With integration of NNSA-directed revisions to the accident analysis, the NNSA is satisfied that the accident analysis reflects a much more conservative approach to determining offsite doses to the MEOI.

3. **Identified Deficiency.** The elevated-release meteorological calculations are not documented sufficiently to allow reproduction of the results.

   SER/DSA Corrective Action Implementation 3 (Accident Analysis): The NNSA has confirmed that the DSA Accident Analysis has provided sufficient detail to understand the parameters used in modeling the release of radioactive material from TA-54 Area G. With the information provided, the NNSA was able to perform independent calculations to confirm the analysis and results. The important parameters are re-iterated in this SER. This deficiency has been addressed in the DSA.

4. **Identified Deficiency.** Overall, the documents composing the AB do not demonstrate a strategy for dealing with the problems of a very short site-boundary distance in a manner that is consistent with the current standards. As a result, the AB is left vulnerable to speculation. The lack of control specification cited in the next section is a direct result of this strategy problem.

   SER/DSA Corrective Action Implementation 4 (Accident Analysis): The DSA adequately documents the boundaries used in the analysis. While the accident analysis adequately describes the consequences at the site boundaries, it is clear there is a lack of safety systems employed at TA-54 Area G. The NNSA recognizes this and has made clear throughout this SER that the most viable method of reducing consequences at the site boundary is to reduce the material at risk on site. This will be done by transferring TRU waste drums to WIPP and through a step-down reduction approved MAR (LCO MAR limitation) in order to preserve the gains in nuclear safety. NNSA views these two controls as the most viable methods of dealing with the consequences at the site boundary. Other controls that have been claimed in the DSA are clearly derived and defined in the DSA and TSRs. Given this, the NNSA believes that this deficiency has been corrected.

Recommendations.

- Fire and seismic releases need to be reexamined with the intent of defining the spectrum of analytical results attainable based on various assumptions. In this way, the extent of any potential problems in terms of MOI dose vs. evaluation guidelines (EGs) will be known. The current SAR upgrade project is doing this.

  SER/DSA Recommendation Implementation 1 (Accident Analysis): The DSA presents a approach of defining a spectrum of conditions particularly within the fire and seismic analysis. The NNSA recognizes that analysis results are highly assumption-driven and perturbation of assumptions will yield significantly different results. LANL has addressed this concern with the spectrum of accidents that were analyzed in this DSA.

- If there are any problems meeting the EGs, discussions should be initiated with the DOE to define what mix of reasonably conservative and best-estimate assumptions might be appropriate (as opposed to absolutely bounding every parameter), and what potential control designations or modifications might be appropriate.

  SER/DSA Recommendation Implementation 2 (Accident Analysis): The negotiation between the NNSA and LANL for appropriate controls has yielded a control set for Area G that can be relied on to prevent or mitigate the postulated accidents. Absolutely bounding accidents can yield unrealistic results. However, for those parameters in the accident analysis that can be rigorously defended, the NNSA is able to accept more realistic values. For parameters that are not clearly understood and cannot be technically defended, more conservative bounding parameters are necessary to assure that the analysis is adequate to bound the postulated hazards and controls. The NNSA believes that the DSA has improved significantly over the previously approved 1995 SAR in this regard.

AB Controls

1. **Identified Deficiency.** Identification of safety SSCs and programs in the defense-in-depth and worker safety sections is inadequate to either fully define the principal safety issues at the facility or to properly support safety SSC and TSR designation.

   SER/DSA Corrective Action Implementation 1 (AB Controls): The DSA adequately describes the safety SSCs and programs that are derived out of the hazards analysis for defense in depth and worker safety. A listing of such is included in Section 4 of the SER. The NNSA recognizes that there is a lack of adequate safety SSCs at Area G. They are also very limited in the planned improvements that they can propose due to the associated high cost of improving facilities that can provide necessary confinement of material. This is why the NNSA is making a case for removal of high content TRU waste drums to the Waste Isolation Pilot Plant and is making a requirement herein that the site institute a step-down LCO MAR limitation in the TSRs. With the implementation of these controls, the NNSA believes that the facility adequately addresses this deficiency.

2. **Identified Deficiency.** Only one safety SSC designation is made—the DVS confinement in the TWISP SAR. Based on the information available, this appears to be an incomplete accounting of safety–significant equipment, independent of the safety-class issue (e.g., HEPA filtration, lightning protection, and some fire controls).

   SER/DSA Corrective Action Implementation 2 (AB Controls): The DSA and TSRs identify four (4) safety class SSCs and three (3) safety significant SSCs. This is a significant improvement over that in the 1995 SAR. However, NNSA recognizes that there are insufficient safety SSCs that the facility can rely on to prevent or mitigate accidents at the site. The removal of high content TRU waste drums to the Waste Isolation Pilot Plant and instituting a step-down LCO MAR limitation in the TSRs in conjunction with naming of additional safety class and safety significant SSCs at Area G provides a better balance of controls at Area G.

3. **Identified Deficiency.** Chapter 5 Derivation of TSRs, in both SARS does not identify all relevant controls, and is not in complete agreement with the actual TSR documents. The exclusion of Limiting Conditions for Operation also may be inappropriate.

   SER/DSA Corrective Action Implementation 3 (AB Controls): The controls identified in the DSA have been adequately derived resulting in TSR controls. The DSA has resulted in a complete set of controls found to be adequately derived from the hazards analysis. With the NNSA-directed changes to the TSRs, there is a proper balance of LCOs, Administrative Controls, and TSR Design Features. The bases for the NNSA-directed controls in the SER are required to be integrated into the DSA at the first annual update.

4. The specification of controls should derive from an integrated development of defense-in-depth and worker safety definitions in the HA and augmented by specific clarifications from the accident analysis. This approach is missing, and there is no consistent train of logic flowing from

hazard and accident analysis to safety SSC and TSR designation. This fundamentally compromises the USQD process.

SER/DSA Corrective Action Implementation 4 (AB Controls): As stated above, the DSA has resulted in a complete set of controls found to be adequately derived from the hazards analysis. With the NNSA-directed changes to the TSRs, there is a proper balance of LCOs, Administrative Controls, and TSR Design Features. The bases for the NNSA-directed controls in the SER are required to be integrated into the DSA at the first annual update.

Recommendations

1. Identifying controls and designating selected controls as safety SSCs should be based on the process specified in DOE-STD-3009-94. The key elements of this process are as follows:

   - A thorough HA that identifies, to the extent reasonably possible, a complete set of accident scenarios
   - An estimate of the unmitigated consequences for scenarios should all safety features fail
   - Identification of the significant preventive and mitigative safety features and administrative controls for each scenario
   - Summation of the above information into detailed defense-in-depth and worker safety sections that define the complete list of potential safety SSCs and TSRs and then provide the rationale for designating safety-significant SSCs, their associated TSRs, and any TSRs for administrative programs
   - Clarification of any requirement to designate safety-class SSCs, as well as documentation of any relevant limiting parameter or phenomena specification in accident analysis
   - Analysis of safety SSCs for functionality within the bounds of accident environments defined in the hazard and accident analysis
   - Derivation of TSRs by identifying those aspects of controls requiring ongoing support to maintain functionality as defined in the hazard and accident analyses and development of performance requirements for safety SSCs

   The end product should be a consistent logic train moving through Chap. 3-5.

   SER/DSA Recommendation Implementation 2 (AB Controls): The controls derived in the DSA and documented in the TSR have been derived using the above process.

2. The defense-in-depth posture for the facility should be defined succinctly. Specifically, 24-h fire detection and response capabilities should be examined.

   SER/DSA Recommendation Implementation 2 (AB Controls): LANL, in the DSA, has generally performed an adequate hazards analysis that identifies those defense in depth and safety significant controls. Specifically regarding the fire detection and response capabilities, the NNSA has directed LANL (by Condition of Approval) to perform an evaluation of upgrading the fire detection systems at TA-54 Area G. Also, as a Condition of Approval of the DSA and TSR, LANL is required to develop an updated Fire Hazards Analysis and ensure that recommendations (controls) developed in the FHA be integrated into the DSA by the first annual update. This was directed by the NNSA because of previous inadequate integration of FHA recommendations into the DSA and utilization of a FHA that appeared to be outdated. Based on the above, this recommendation has been addressed.

3. Any control issues arising from recommendations in Secs. 4.2, Hazard Identification/Evaluation, and 4.3, Accident Analysis, of this report should be closed out as part of the current SAR upgrade effort. Examples of additional controls for consideration are listed below.

- Specific limits on combustibles and types of material used
- Specific limits on fire initiation sources such as vehicle fuels and spark sources
- Limitations on storage, such as container curie loading (total quantity loading and isotope types) for specific locations and aisle spacing
- Limiting operations based on continuous air monitor (CAM) availability and radiation levels
- Limiting DVS and compactor operations based on required subsystems such as ventilation and HEPA filter operability

SER/DSA Recommendation Implementation 3 (AB Controls): The controls derived in the DSA and documented in the TSR have been derived using methodology in DOE-STD-3009. The DSA has considered the above controls and are appropriately evaluated in the HA for defense in depth, safety significant and safety class designation.

Control Implementation

1. **Identified Deficiency.** Previous sections of this report have identified the lack of a comprehensive HA with associated identification of controls. This has cascaded to a failure to identify detailed controls in the TSRs. Although the facility and operations personnel have established a set of controls, many are based on best management practices rather then a direct result of comprehensive hazard and accident analyses. This process has resulted in the lack of a linkage of the controls to the hazard and accident analyses.

   SER/DSA Corrective Action Implementation 1 (Control Implementation): The DSA and TSR approved herein are derived from a rigorous HA. NNSA has been able to follow direct linkage from the HA to the accident analysis to TSR derivation. While the NNSA has discovered issues with the DSA, all will be corrected by first the annual update of the DSA and TSRs. NNSA has made the determination that, pending implementation of TSR controls and SER Conditions of Approval, the DSA and TSRs meet the requirements of 10CFR830 Subpart B.

2. **Identified Deficiency.** The TSRs for Area G and TWISP comprise facility management and operations programs that are described in very general terms. More explicit TSRs would be more effective in ensuring implementation of the precise elements of the program taken credit for in the HA and/or accident analysis.

   SER/DSA Corrective Action Implementation 2 (Control Implementation): The approved DSA and TSRs, with SER Conditions of Approval implemented, meet 10CFR830 Subpart B requirements. Section 5 of the TSR document provides detail on specific important elements of Administrative Control programs. For the TSR LCOs and Design Features, detailed bases statements are provided.

3. **Identified Deficiency.** Several USQDs describe, and take credit for, controls that currently are not included in the TSRs. For example, USQD-54G-002, R.0, which covers solidification of uranium chips and turnings, takes credit for lift height limits of 4 ft. to be used in the solidification process. Controls described and taken credit for in USQDs are not incorporated into the TSR set; therefore, the process of incorporating required controls into operations procedures is not straightforward.

SER/DSA Corrective Action Implementation 3 (Control Implementation): The DSA and TSRs constitute an entirely new safety basis for the Area G facility. The controls derived in this new analysis may be different than that identified in previous USQDs. Because this analysis is entirely new, the controls identified in USQDs may or may not appear as TSR controls in the new DSA and TSRs. However, they are still captured in the administrative controls programs and/or implementation procedures.

Recommendations

- As discussed previously, comprehensive hazard and accident analyses should be performed as part of the SAR update effort, and a comprehensive set of controls should be identified. Any controls identified by this process that are not implemented already will have to be implemented.

  SER/DSA Recommendation Implementation 1 (Control Implementation): A Condition of Approval (COA) in this SER directs that an Implementation Plan (IP) for TSR controls be provided to the NNSA for approval within 45 days from the date of the SER. The IP is to include milestones and dates for implementation of controls and is approved by the NNSA Senior Authorization Basis Manager.

- Controls identified during the SAR update effort should be defined in specific terms in the TSRs. For example, instead of describing the Fire Protection Program in general terms, the TSRs should list the specific elements of the Fire Protection Program (e.g., manual fire suppression, fire extinguisher training) that the HA or accident analysis list as preventive and/or mitigative features.

  SER/DSA Recommendation Implementation 2 (Control Implementation): The NNSA has confirmed that specific safety bases for important elements of designated TSR Administrative Controls (ACs) have been identified in Section 5 of the TSRs. These have been derived from the DSA.

- The USQ process should include provisions to ensure that any new controls taken credit for in USQDs (positive or negative) are incorporated into the TSRs.

  SER/DSA Recommendation Implementation 31 (Control Implementation): 10CFR830 Subpart B states "DOE Guide 424.X, Implementation Guide for Addressing Unreviewed Safety Question (USQ) Requirements, provides DOE's expectations for a USQ process." DOE Guide 424.1-1 states "The contractor must keep the facility DSA current by updating it annually. All changes at the facility should be reflected in these updates at an appropriate level of detail, including those that were authorized through the USQ process." The NNSA is satisfied that the requirement for updating the DSA and TSRs annually to incorporate changes is clear.

APPENDIX B

Quality Deficiencies Requiring Correction at First Annual Update of DSA

There were numerous issues in the DSA and TSRs that had to do with the miscalculations, misstatements, use of incorrect values, etc. that detract from the quality of the document. While none were found to have significant impact on the accident consequences or controls, document quality is lacking. NNSA's expectation is that the documents have been thoroughly reviewed by technical editors and by a LANL Independent Review Team. This obviously did not occur since the below items were of a nature that could be found by simply reading the document and performing calculations for confirmation purposes. NNSA's function is not one of quality assurance, but rather of Approval Authority. The NNSA would encourage the Laboratory to place more emphasis on document quality.

It would be impractical to list all of the issues that NNSA found nor does the following examples identify all of the problems or deficiencies that may exist. It is incumbent on LANL to review the document in its entirety to ensure all of the problems have been found. NNSA is providing a sampling to illustrate these obvious mistakes. Again, this is indicative of inadequate QA and lax independent review of the document.

E.4/pg. 3/para 1/ln 3 – "... the predominant hazardous materials are metals that are present in a monolithic form, ..." but the entire document addresses wastes in various container of which 21% in combustible (trash), 67.1% is non-combustible (form is defined as metal, glassware, etc.), 11.9% non-combustible/non-dispersible waste (cemented, de-watered slurries, sludges, precipitates, ion exchange resin). Therefore, for the statement to be true, all the non-combustible/dispersible material must be monolithic metal;

3.4.2.5.1/pg 3-176/paragraph 1/ln 2 & 5 cites 12 TRU waste storage domes; while, only 11 are so designated in Section 2.4/pg 2-4 "Facility Structure". Bldg. 3-33 is designated as the "Drum Preparation Facility"; although, it is used in the Accident Analyses as a representative site for a cluster of waste storage domes. If Bldg. 3-33 is considered a waste storage dome it should be so designated;

3.4.2.6.1/pg. 3-183/Struc. Cap. Drums/paragraph 2/ln 4 – "Area G is used only for solid storage, so the potential for corrosion from inside is limited." But on pg. 3-189/ARF & RF/paragraph ln 3 "cemented waste" are cited as being present. This waste form was previously described a having de-watered sludge, slurries and precipitates that contain appreciable quantities of water and are not brittle. Even in HDPE liner, the contents are exposed to the interior of the drums and, since the material evaporated from these material is not known, it can not be determined that the statement is accurate;

3.4.2.7.2/pg. 3-200/ARF & RF/paragraph 1/ln 2 – "The ARF and RF for both cases is 1E-3 and 0.1" but the ARF/RF values used in the Source Term calculations on the following page are 1E-3/0.3;

3.4.2.8.2/pg. 3-212/Case 2, 1st bullet/ln 5 – states "an additional 134 m^2 (550 m^2 – 100 m^2) of array ..."

The fire area for a 300-gal liquid fuel fire is 244-m^2 not 550-m^2 and 550 m^2 – 110-m^2 $\neq$ 134-m^2;

3.4.2.8.2/p[g. 3-215/Case 2/3rd bullet – "33% x (330 drums x 243 drums) = 181 drums … 0.33[3030 drums][243 drums] ≠ 181 drums;

3.4.2.8.3/pg. 3-219/paragraph 3/ln 4 & 7 – " … the dose-to-source-term ratio of 0.66 rem/PE-Ci was used for the full intensity phase of the fire …" although a value of 0.62 rem/PE-Ci was used in the calculations on the next pg. 3-220; "… the dose-to-source-term ratio for this rate (0.1 MW fire) is 30.9-rem/PE-Ci." Although a value of 28.8 rem/PE-Ci was used on the nest pg. 3-220;

3.4.3/Operational Accidents/paragraph 1-4 - "Therefore, the only more severe condition or equipment failure identified for beyond design basis accident is degraded waste container." This may be the only aspect considered but other conditions (e.g. a larger aircraft that could impact 2 domes end –on, wind and earthquakes beyond PC-3, etc.) can be postulated and this represents a gratuitous inaccurate statement;

3.4.3/Natural Phenomena Events/paragraph 1/ln 8 – "Therefore, a beyond design basis wind event could cause multiple dome failures but the resulting dose consequences would not be significantly higher. The dose to the MEOI would not exceed the EG." The fact that all domes may fail at a PC-3 (Evaluation Basis Event) has been cited, below. The independently calculated dose already exceeds the EG. Another example of an gratuitous inaccurate statement;

The equation states that:

TEDE (rem) = 0.5[(5E-4) X MAR X DR) PE-Ci X 2 rem/PE-Ci] + 0.5[4.5E-2 X MAR DR} = 0.23 MAR X DR.

The units for the 1st component is (a unitless coefficient) X 5E-4 (a fraction) X ~~PE-Ci~~ X rem/~~PE-Ci~~= Rem. The 2nd component is (a unitless coefficient) X PE-Ci X (fraction) = PE-Ci and is not in the same units as the 1st component. Thus, the sum does not equal 0.23 X MAR X DR = rem; since, the 2nd component results in a value with units of PE-Ci. This comment was made in the previous 100% DSA DRAFT Feb 03. Correct the equation to ensure that the proper units are carried throughout the equation.

"The RLW Facility and Operations team leader is responsible for maintaining proper …". Fifg.6.3-1 "FWO-WFM Group Organization" shows that the SW Facility Support, Team Leader but with no staff. The RLW Facility & Operations staff includes Process Engineers, Analytical Services, Operations Supervisor, Systems Engineers. Although mention in previous text, the Solid Waste organization has a Support Team Leader but no Operations Supervisor or service staff. It appear that the RLW Facility and Operations Team Leader operates the Solid Waste Management Operation. The confusion/lack of clarity is inconsistent with the eight guiding principals in Section 6.3.12.2.4 that states:

2nd bullet – "Line management safety and environmental responsibility";
3rd bullet – "Clear roles";

Action: Correct the AREA G DSA to address these issues of quality and to clarify the roles and responsibilities of the Area G personnel

Appendix C

NNSA Independent Lightning Strike Frequency Analysis

Using the methodology developed by E. T. Pierce for determining the effective strike area, NNSA determined that the frequency for lightning strikes to Area G is nearly 65% greater than what was calculated in the TA-54 Area G DSA, Appendix 3-H.

The DSA presented a lightning strike frequency of 0.84, for all of the domes, and rounded up to unity, whereas NNSA calculations show a total frequency of 1.4 strikes per year to the domes. The data NNSA used was obtained from Chapter 2 of the DSA along with additional information supplied by LANL for the specific dome heights. The data are provided in Table 1 below. The analysis for a single dome follows.

Summing over all 13 domes listed in Table 2.1 of the DSA shows the strike frequency for Area G to be 1.4 per year. This is more than 65% higher than that calculated in Appendix H to Chapter 3.

Table 1: Calculated Lightning Strike Frequency for TA-54 AREA G Domes

Dome	Frame Design	Door access	Lightning Strike Frequency (1/year)	Dome Height (m)	Floor Area
54-33	Arch type	Clamshell	0.109	7.9	465 m^2 (5,000 ft^2)
54-48	Arch type	Clamshell	0.148	7.3	1,790 m^2 (19,250 ft^2)
54-49	Arch type	Clamshell	0.174	7.9	3,020 m^2 (32,500 ft^2)
54-153	Arch type	Clamshell	0.149	7.9	1,820 m^2 (19,560 ft^2)
54-224	Arch type	Roll-up	0.115	8.2	610 m^2 (6,600 ft^2)
54-226	Arch type	Roll-up	0.154	10.7	2068 m^2 (22,250 ft^2)
54-229	Arch type	Roll-up	0.154	9.4	2,025 m^2 (21,800 ft^2)
54-230	Arch type	Roll-up	0.154	9.4	2,025 m^2 (21,800 ft^2)
54-231	A-Truss	Roll-up	0.154	9.4	2,025 m^2 (21,800 ft^2)

Table 1: Calculated Lightning Strike Frequency for TA-54 AREA G Domes (cont.)					
54-232	A-Truss	Roll-up	0.154	9.4	2,025 m^2 (21,800 ft^2)
54-281	A-Truss	Roll-up	0.104	7.9	349 m^2 (3,750 ft^2)
54-283	Arch type	Clamshell	0.138	7.9	1,400 m^2 (15,000 ft^2)
54-375	A-Truss	Roll-up	0.154	11.3	2068 m^2 (22,250 ft^2)

Notes: 54-33 floor area is gross and includes 350 m^2 (3,750 ft^2) covered by the aluminum arch-frame building and 116 m^2 (1,250 ft^2) covered by the annex building.

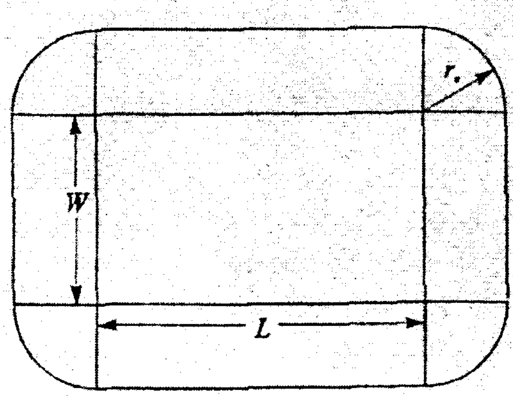
Areas of domes 54-226 and 54-375 are estimated.

Reference: Lightning Strike Frequency Analysis (Cianos, N., and E. T. Pierce, A Ground-Lightning Environment for Engineering Usage, Stanford Research Institute, Menlo Park, August, 1972)

The following calculation is for the largest Dome at TA-54 Area G (Dome 54-49)
Dome 54-49 area = 3,020 m^2 with a height of 7.9 m

INPUTS:

$L := \sqrt{3020}$
$L = 54.955$
building length (m)
$W := \sqrt{3020}$
$W = 54.955$
building width (m)
$H := 7.9$
Building or stack height (m)
$N_g := \frac{6}{\left(1000^2\right)}$
Lightning ground flash density $\frac{\text{flashes}}{m^2 \cdot yr}$



Area values for TA-54 Area G Domes reference Table 2-1, Ch 2 pg 6 of DSA

FUNCTIONAL RELATIONSIHIPS:

$$r_a(h) := 80\sqrt{h}\cdot\left(e^{-0.02\cdot h} - e^{-0.05\cdot h}\right) + 400\left(1 - e^{-0.0001\cdot h^2}\right)$$

Bulding lightning capture radius (m)
$r_a(H) = 43.001$
Building lightning capture radius (m)

$$A_{attr}(l, w, h) := l\cdot w + 2\cdot r_a(h)\cdot(l + w) + \pi\cdot r_a(h)^2$$

total building effective lightning attractive area m^2

$$A_{attr}(L, W, H) = 1.828\times 10^4$$

m^2

$P := N_g\cdot A_{attr}(L, W, H)$

P = Annual expected bounding number of lightning strikes on facility (flashes/year)

P = 0.11

$P_{total} = \Sigma_{domes}(P_d) = 1.4$