

SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT FOR THE **CONTINUED OPERATION OF SANDIA NATIONAL LABORATORIES, NEW MEXICO**

May 2026

Volume 2: Appendices A–K



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Appendix A – Supplemental Supporting Information

Appendix A provides supplemental information to support the material presented in Chapters 1 through 5 of the *Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico* (DOE/EIS-0556) (SNL/NM SWEIS). This appendix is organized to assist the reader in connecting this information to the chapters supplemented here. Section A.1 supplements Chapter 1, Section A.2 supplements Chapter 2, Section A.3 supplements Chapter 3, Section A.4 supplements Chapter 4, and Section A.5 supplements Chapter 5.

A.1 INTRODUCTION – SUPPLEMENTAL INFORMATION

This section of the site-wide environmental impact statement (SWEIS) provides supplemental and supporting information to the material presented in Chapter 1 of the main document. The primary information in this section is associated with documents prepared under the National Environmental Policy Act (NEPA) relevant to this SNL/NM SWEIS.

A.1.1 Introduction

This section is reserved.

A.1.2 Background

This section is reserved.

A.1.3 Purpose and Need for Agency Action

This section is reserved.

A.1.4 Proposed Action and Alternatives in This New Site-wide Environmental Impact Statement for Sandia National Laboratories/New Mexico

This section is reserved.

A.1.5 Relationships to Other Department of Energy National Environmental Policy Act Documents and Information Sources

This section provides information about NEPA and other documents relevant to this SNL/NM SWEIS and listed in Table 1-2 in Chapter 1. The information is provided for programmatic NEPA documents relevant to Sandia National Laboratories/New Mexico (SNL/NM) (Section A.1.5.1), site-specific NEPA documents (Section A.1.5.2), and other documents related to the agency's purpose and need (Section A.1.5.3).

Various NEPA analyses related to activities at SNL/NM and other U.S. Department of Energy (DOE) facilities in the Albuquerque area undertaken since the 1999 SWEIS (DOE 1999) and its associated Record of Decision (ROD) include programmatic environmental impact statements

(EISs) and several environmental assessments (EAs) with their respective Findings of No Significant Impact (FONSIIs).

According to its NEPA implementing procedures, DOE evaluates site-wide NEPA documents at least every 5 years by preparing a supplement analysis (SA). Based on the SA, DOE determines whether the existing SWEIS is adequate or if a new SWEIS or supplement to the existing EIS needs to be prepared. The determination and supporting analysis are made publicly available. This SNL/NM SWEIS identifies several programmatic (or site-wide) EISs relevant to this SWEIS. Many of these programmatic EISs have been reevaluated or updated through SAs. Where applicable in the descriptions that follow, the National Nuclear Security Administration (NNSA) has indicated whether SAs have been prepared.

For preparation of this SNL/NM SWEIS, NNSA incorporates information by reference and tiers from relevant previous NEPA documents to succinctly present the analysis. Information from these documents provides additional context for understanding the current status of NEPA compliance, which forms the foundation for preparing this SWEIS. The following sections identify programmatic and site-specific NEPA documents, as well as other documents that are most relevant to this SWEIS analysis.

A.1.5.1 Programmatic NEPA Documents

Programmatic Environmental Impact Statement for Stockpile Stewardship and Management (DOE/EIS-0236 [DOE 1996]). During the mid-1990s, DOE prepared the Stockpile Stewardship and Management Programmatic Environmental Impact Statement (SSM PEIS) to evaluate alternatives for maintaining the safety and reliability of the U.S. nuclear weapons stockpile and preserving competencies in nuclear weapons in the post-Cold War era. With regard to SNL/NM activities, the SSM PEIS analyzed the potential impacts of (1) constructing and operating the National Ignition Facility (NIF) at SNL/NM and (2) transferring the majority of missions from the Kansas City Plant (now the Kansas City National Security Campus [KCNSC]) to SNL/NM. The SSM PEIS ROD published in the *Federal Register* (FR) on December 26, 1996 (61 FR 68014), documents DOE's decision to (1) proceed with the construction and operation of the NIF at Lawrence Livermore National Laboratory and (2) downsize the existing facilities at the Kansas City Plant (now KCNSC). Consequently, as a result of the SSM PEIS, there were no major changes at SNL/NM.

Final Complex Transformation Supplemental Programmatic Environmental Impact Statement [Complex Transformation SPEIS] (DOE/EIS-0236-S4 [NNSA 2008]). In 2008, NNSA prepared the Complex Transformation SPEIS, a supplement to the 1996 SSM PEIS, to evaluate the potential environmental impacts of alternatives for transforming the nuclear weapons complex into a smaller, more efficient enterprise that could respond to changing national security challenges and ensure the long-term safety, security, and reliability of the nuclear weapons stockpile. With regard to SNL/NM activities, the Complex Transformation SPEIS analyzed the potential impacts of the following alternatives:

- (1) No-Action Alternative: Continue current activities related to explosives research and development (R&D), tritium R&D, hydrotesting, and major environmental test facilities (ETFs).
- (2) Transfer explosives R&D activities to other sites.
- (3) Receive explosives R&D activities from other sites.
- (4) Reduce hydrotesting facilities in place.
- (5) Consolidate major ETFs in place.
- (6) Consolidate major ETFs to SNL/NM.
- (7) Receive SNL/California Weapons Support Functions.

The Complex Transformation SPEIS ROD, published in the *Federal Register* on December 19, 2008 (73 FR 77656), documents NNSA's decision to consolidate major ETFs at SNL/NM and conduct infrequent operations requiring Category I/II special nuclear material (SNM)¹ in a security campaign mode.²

Final Environmental Impact Statement for the Waste Isolation Pilot Plant (DOE/EIS-0026 [DOE 1980]) and associated supplemental EISs DOE/EIS-0026-S1 (DOE 1990) and DOE/EIS-0026-S2 (DOE 1997a) (69 FR 39456). These NEPA documents analyzed disposal of DOE's transuranic (TRU) waste, including TRU waste produced/stored at SNL/NM, at the Waste Isolation Pilot Plant (WIPP) outside of Carlsbad, New Mexico. Since the WIPP began receiving TRU waste, there have been 10 total TRU waste shipments made from SNL/NM to the WIPP. The last shipments were in July 2020, when two TRU waste shipments from SNL/NM were delivered to the WIPP. Those shipments were the first shipments from SNL/NM since 2012. Currently, about 1.76 cubic meters (m³) of mixed TRU (MTRU) waste remains onsite, designated for eventual transport to the WIPP (SNL 2021a).

Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (DOE/EIS-0200 [DOE 1997b]). This SWEIS analyzed management and disposal of DOE's hazardous and radioactive waste, including waste produced at SNL/NM, at various DOE and commercial

¹ SNM is a category of material that is subject to regulation under the Atomic Energy Act of 1954, as amended, and consists primarily of fissile materials. Such materials include plutonium, uranium (U)-233, uranium enriched in the isotopes of U-233 or U-235, and any other material that the U.S. Nuclear Regulatory Commission (NRC) determines to be SNM. SNM does not include source material. Category I/II SNM requires the highest security protection. In 2008, NNSA completed the removal of SNL/NM's Category I/II SNM. SNL/NM no longer stores or uses these categories of SNM on an ongoing basis, although it may use Category I/II SNM for limited periods in the future (73 FR 77644).

² Many other decisions were made in this ROD, but only the ETF consolidation decision would have changed operations at SNL/NM. Following this ROD, the relocation of ETF operations required NNSA to refurbish existing facilities or build new facilities at SNL/NM; however, this was not done, and consequently, facilities at other sites continue to operate to meet programmatic needs.

facilities in the United States. NNSA manages and disposes of hazardous and radioactive waste generated at SNL/NM in accordance with the ROD for this PEIS, which was issued on February 25, 2000 (65 FR 10061).

A.1.5.2 Site-Specific NEPA Documents

Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281 [DOE 1999]) (1999 SWEIS). In October 1999, DOE issued the 1999 SWEIS, which analyzed DOE's proposal to continue operating SNL/NM. DOE assessed three alternatives for continued operation of SNL/NM: (1) No Action, (2) Reduced Operations, and (3) Expanded Operations. The Expanded Operations Alternative (exclusive of the Microsystems Engineering, Science and Applications [MESA] Complex) was DOE's Preferred Alternative. Under the Expanded Operations Alternative, DOE would expand operations at SNL/NM as the need arose (until 2008), subject to the availability of congressional appropriations, to increase the level of existing operations to the highest reasonably foreseeable activity levels analyzed in the 1999 SWEIS. The Preferred Alternative would implement expansion only at the existing Microelectronics Development Lab, without addition of the MESA Complex. In the ROD, published in the *Federal Register* on December 15, 1999 (64 FR 69996), DOE decided to implement the Expanded Operations Alternative without the MESA Complex (i.e., the Preferred Alternative in the Final SWEIS).³

Since issuance of the 1999 SWEIS and its ROD, the SNL/NM environment has changed, and additional information about the SNL/NM environmental setting has become available. Security requirements have also evolved in response to changes in recognized threats to facilities and materials at SNL/NM. In addition, NNSA has prepared four SAs based on the 1999 SWEIS. Three of the SAs dealt with implementing new or changed operations and replacing facilities; the fourth assessed whether potential environmental impacts from site operations remained within those projected in the 1999 SWEIS for the level of operations selected in the ROD. These SAs are identified as follows:

Supplement Analysis; Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico, Reestablishing Long-Term Pulse Mode Testing Capability at the Annular Core Research Reactor, Sandia National Laboratories, New Mexico (DOE/EIS-0281-SA-01 [DOE 2001]). Analyses performed indicated that the environmental impacts of the proposed reestablishment of Defense Programs testing at the Annular Core Research Reactor (ACRR) are within the envelope of consequences established in the 1999 SWEIS.

Supplement Analysis; Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico, Isentropic Compression and Flyer Plate Experiments Involving Plutonium at the Z and Saturn Accelerators (DOE/EIS-0281-SA-02 [DOE 2002]). Analyses

³ As discussed in the list of EAs, in 2000, DOE analyzed impacts from constructing and upgrading facilities to consolidate operations at SNL/NM and modernize capabilities in microsystem design and production.

performed indicated that the environmental impacts of the proposed experiments at the Z and Saturn Accelerators are within the envelope of consequences established in the 1999 SWEIS.

Supplement Analysis; Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico, Installation of a Petawatt Laser System in TA-IV

(DOE/EIS-0281-SA-03 [DOE 2004]). Analyses performed indicated that the environmental impacts of the proposed addition of petawatt capabilities at the Z-Beamlet Laser Facility/Z Accelerator combination are within the envelope of consequences established in the 1999 SWEIS and subsequent Categorical Exclusions.

Final Supplement Analysis for the Final Site-Wide Environmental Impact Statement for Sandia National Laboratories/New Mexico (DOE/EIS-0281-SA-04 [DOE 2006]). Analyses performed indicated that the environmental impacts of current and projected SNL/NM operations are within the envelope of consequences established in the 1999 SWEIS.

Eight EAs have been issued:

Environmental Assessment for the Microsystems and Engineering Sciences Applications Complex (DOE/EA-1335 [DOE 2000a] and FONSI [DOE 2000b]). This EA analyzed impacts from constructing and upgrading facilities to consolidate operations at SNL/NM and modernize capabilities in microsystem design and production. This project has been completed and is operational.

Final Environmental Assessment for the Test Capabilities Revitalization at Sandia National Laboratories, New Mexico (DOE/EA-1446 [DOE 2003a] and FONSI [DOE 2003b]). This EA analyzed impacts from renovating and demolishing several existing facilities and constructing new facilities to enhance thermal and mechanical test capabilities at SNL/NM. This project has been completed.

Final Environmental Assessment for the Center for Integrated Nanotechnologies at Sandia National Laboratories, New Mexico (DOE/EA-1457 [DOE 2003c] and FONSI [DOE 2003d]). This EA analyzed impacts from constructing and operating a Center for Integrated Nanotechnologies (CINT) and establishing a CINT Gateway at SNL/NM. This project has been completed and is operational.

Final Environmental Assessment for the Proposed Consolidation of Neutron Generator Tritium Target Loading Production (DOE/EA-1532 [DOE 2005]). This EA analyzed impacts from centralizing neutron generator (NG) development and manufacturing processes at SNL/NM. This project has been completed and is operational.

Final Environmental Assessment for Proposed Construction and Lease of New Facilities for the Department of Energy, National Nuclear Security Administration, Office of Secure Transportation (Albuquerque Transportation and Technology Center) Albuquerque, New Mexico (GSA 2006). This EA analyzed alternatives, including constructing and leasing new facilities, to meet current and future needs of Office of Secure Transportation administrative and operational functions. This project has been completed and is operational.

Final Environmental Assessment for the Expansion of Permitted Land and Operations at the 9940 Complex and Thunder Range at Sandia National Laboratories, New Mexico

(DOE/EA-1603 [DOE 2008a] and FONSI [DOE 2008b]). This EA analyzed impacts from increasing explosives test and training activities and expanding operations at the 9940 Complex and Thunder Range at SNL/NM. The ranges in this and other EAs at SNL/NM are detailed in Section A.3.2.3. This project has been completed and is operational.

Final Environmental Assessment for the Removal Actions at the Technical Area III Classified Waste Landfill, Sandia National Laboratories, New Mexico

(DOE/EA-1729 [DOE 2010a] and FONSI [DOE 2010b]). This EA analyzed impacts from removal, demilitarization, and disposal of the contents of the Classified Waste Landfill in Technical Area (TA) III. This project has not been completed.

Final Environmental Assessment for Operations, Upgrades, and Consolidation at the Western Command Site, New Mexico

(DOE/EA-1906 [DOE 2012a] and FONSI [DOE 2012b]). This EA analyzed impacts from consolidating Western Command Operations into a new complex at the existing Agent Operations Western Command and Training Facility. This project has been completed and is operational.

A.1.5.3 Other Documents

Fiscal Year 2024 Stockpile Stewardship and Management Plan – Report to Congress (NNSA 2023). This document describes NNSA’s plans to ensure the safety, reliability, and performance of the U.S. nuclear weapons stockpile mission to carry out national security responsibilities by maintaining a safe, secure, and effective nuclear deterrent; preventing, countering, and responding to the threats of nuclear proliferation and terrorism worldwide; and providing naval nuclear propulsion.

Nuclear Posture Review (DoD 2022). This document assesses previous nuclear policies and requirements and focuses on identifying the nuclear policies, strategy, and corresponding capabilities needed to protect the Nation in the deteriorating threat environment that confronts the United States, its allies, and partners. The 2022 *Nuclear Posture Review* provides guidance for the nuclear force posture and policy requirements needed now and in the future.

A.2 SANDIA NATIONAL LABORATORIES: MISSIONS, PORTFOLIOS, PROGRAMS, CAPABILITIES, AND MAJOR FACILITIES – SUPPLEMENTAL INFORMATION

This section provides information that supplements and supports the material presented in Chapter 2 of the SNL/NM SWEIS.

A.2.1 Introduction

SNL plays a significant role in life extension programs (LEPs), modification programs (mods), and alteration programs (ALTs) that extend weapon lifetimes and are carried out without underground nuclear explosive testing. Currently, in support of the Nuclear Deterrence portfolio,

SNL’s top-priority objectives are to sustain and modernize the current stockpile. SNL/NM further supports national security through other portfolios, programs, and capabilities, such as energy security and long-term energy needs, transportation R&D, homeland infrastructure security and resiliency, and advanced science and technology (AS&T). In fact, much of the same infrastructure used to support national security also supports these other portfolios.

A.2.2 Overarching DOE and NNSA Missions

Figure A-1 depicts NNSA’s mission priorities, as described in the NNSA Strategic Vision (NNSA 2022a). NNSA uses world-class science, technology, and engineering to accomplish mission priorities and employs an adaptive workforce, manages a resilient infrastructure, and conducts operations in an integrated Nuclear Security Enterprise (NNSA 2022a).



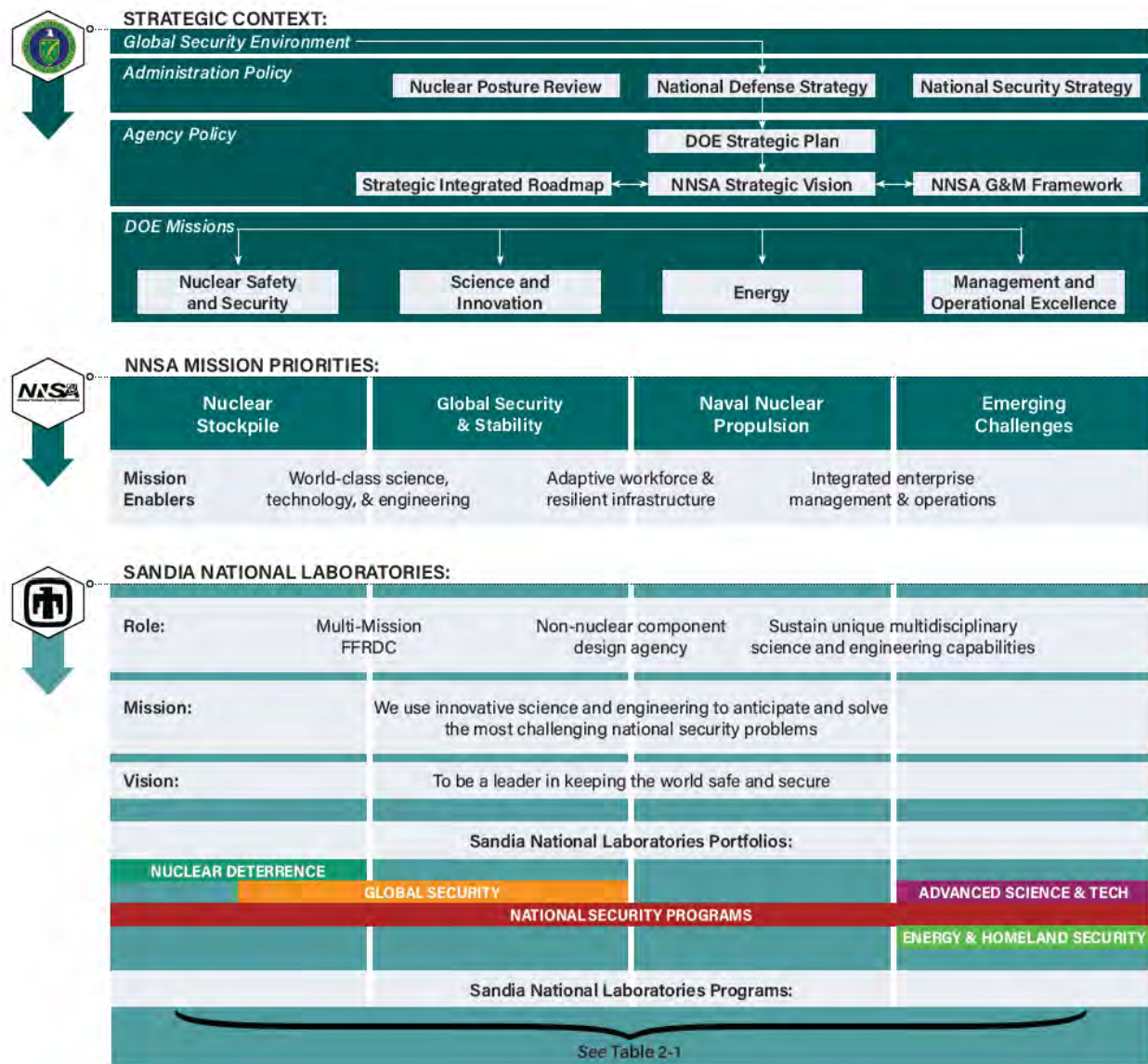
Source: NNSA 2022a.

Figure A-1. NNSA Mission Priorities and Mission Enablers

LEPs, Mods, and ALTs
Life Extension Programs (LEPs): Activities addressing aging and performance issues within the stockpile to extend the service life while increasing safety and security. Modifications (Mods): Changes in operational capability. A mod may enhance the margin against failure, increase safety, improve security, or replace limited-life components. Alterations (ALTs): Material changes to, or prescribed inspections of, a nuclear weapon or major assembly that does not alter its operational capability yet is sufficiently important to the user (regarding assembly, maintenance, storage, or test operations).
Source: NNSA 2022b.

A.2.3 Overview of SNL/NM Portfolios, Programs, and Capabilities

Figure A-2 shows NNSA’s strategic framework at SNL/NM.



Source: SNL 2022a, as modified.

Figure A-2. SNL/NM Strategic Framework

A.2.3.1 Nuclear Deterrence Portfolio

NNSA's Stockpile Stewardship and Management Plan describes NNSA's efforts to implement the Administration's Nuclear Posture Review by maintaining the nuclear stockpile's safety, security, and effectiveness over the next 25 years. SNL executes this nuclear deterrence mission as described in the Plan. SNL's nuclear deterrence mission includes nuclear weapons R&D, design, qualification, testing, certification, and systems integration of all components, subsystems, and systems to arm, fuze, and fire a weapon to military specifications, while ensuring safety and security. The integration role is evident in three key areas:

- integration of all non-nuclear components, systems, and subsystems;
- integration between a weapon's non-nuclear portion and its nuclear explosives package; and
- integration of a weapon with its military delivery platform.

SNL is involved in all current stockpile modernization programs and is responsible for designing the life extension of the Safeguards Transporter and its replacement, the Mobile Guardian Transporter, that securely transports nuclear weapon materials and components to DOE/NNSA partner sites and U.S. Department of Defense (DoD) customer sites. SNL also has production agency responsibilities for non-nuclear weapon components (e.g., power sources; NGs; trusted, strategic radiation-hardened microelectronics). SNL supports infrastructure to meet the design, qualification, testing, and certification requirements of the nuclear deterrence program.

A.2.3.1.1 Stockpile Major Modernization Programs

The Modernization Program portfolio's strategic direction is to sustain the future stockpile by enabling the successful execution of nuclear weapon modernization programs (LEPs and major ALTs) through effective program management and cross-cutting program integration. These modernization activities extend the life of the stockpile, refresh obsolete technology, address security concerns, support secure asset transportation, and support nonproliferation obligations. To capitalize on innovative technical options, SNL leverages previous investments in areas such as technology maturation, AS&T, and Laboratory Directed Research and Development (LDRD). Work within this program includes:

- systems design, testing, and qualification of modernization programs;
- efforts with non-nuclear component groups and physics laboratories to develop, integrate, test, and qualify systems that meet DoD priorities and needs; and
- coordination with DoD to integrate with delivery platforms as well as receive approval as a standard stockpile item before transitioning to stockpile sustainment.

The Non-Nuclear Component Group designs, develops, qualifies, and delivers non-nuclear components. This effort employs hardware and software capabilities and includes components such as safety mechanisms, optomechanical assemblies, structurally hardened firing subsystems, radiation-hardened microelectronics, battery R&D, fuzing components, multi-application firing subsystems, secure data processors and algorithms, high-reliability electronic products, high-energy-density (HED) capacitors, custom cable and connector assemblies, lightning arrestor connectors, custom magnetics and oscillators, and extreme data system engineering solutions.

The Environmental Test Group operates test facilities used across the weapons system lifecycle. Test capabilities must simulate a broad range of normal, abnormal, and hostile environments, using the breadth of engineering disciplines such as aerosciences, fire sciences, fluid mechanics, energetics, shock physics, solid mechanics, structural dynamics, thermal sciences, computational simulation, and engineering analysis. Theory and computational simulation are closely integrated

for designing tests and acquiring validation data across length and time scales to develop the technical basis for complex systems.

The Secure Transportation Group supports the design and development of new and replacement transportation hardware.

A.2.3.1.2 Stockpile Sustainment

Stockpile Sustainment encompasses current stockpile tails, the Multiple Weapon System program, and Weapon Disposition and Dismantlement. Stockpile Sustainment supports surveillance, development, and production scope for these areas. The Multiple Weapon System program focuses on capability sustainment for key functions. The Weapon Disposition and Dismantlement program funds retired systems and the Legacy Hardware Laboratory.

A.2.3.1.3 Production Operations

SNL/NM is responsible for the production of NGs, radiation-hardened microelectronics, power sources, energetics, and other non-nuclear specialty components. Production Operations supports production-specific activities at SNL/NM by providing program base capability sustainment to enable weapon operations. This includes production modeling and analysis, program management, engineering and integration, supplier management, shipping and material management, manufacturing capability sustainment, equipment and material procurement, and production equipment maintenance activities.

A.2.3.1.4 Inertial Confinement Fusion and Assessment Science

Fusion is the dominant source of energy release in a nuclear weapon and therefore an important research topic for stockpile stewardship. The Inertial Confinement Fusion program operates SNL/NM's Z-machine, a HED facility based on pulsed power technology used to create conditions in density, temperature, pressure, and x-ray radiation that approach those in nuclear weapons. The Inertial Confinement Fusion program develops and performs experiments in the areas of fusion, radiation physics, and dense plasma physics. The program also develops new and improved diagnostics for fusion and HED conditions.

Assessment Science develops the capabilities to create, diagnose, and analyze materials, plasmas, and various physical processes at conditions relevant for those encountered in nuclear weapons. The program uses advanced research facilities, including the Z-machine. Assessment Science provides the knowledge and experience needed to design, certify, and assess the Nation's nuclear weapons without underground nuclear testing.

A.2.3.1.5 Advanced Simulation and Computing

Simulation Codes and Models at SNL/NM provides state-of-the-art computer simulation capabilities as part of NNSA's mission to extend the lifetime of nuclear weapons in the stockpile without underground testing. These tools enable scientists and engineers to gain a comprehensive understanding of nuclear weapons and enhance engineering of other innovative products.

High-Performance Computing manages and operates SNL/NM's large-scale and exploratory computing resources that support programs associated with diverse mission areas. These programs include three-dimensional, high-fidelity, physics, and full-system simulation codes required for engineering, safety, and performance analyses of the stockpile. These high-performance computational modeling and numerical simulation capabilities are necessary to support the science-based stockpile stewardship program in the absence of underground nuclear testing.

A.2.3.1.6 Weapon Technology Development

The Weapon Technology Development area encompasses the Technology Maturation portfolio to prepare for future modernization programs, postures, and strategies executed through a continuous demonstrator program and component maturation efforts. It enables testbed activities allowing the maturation of system architectures, subsystems, and/or components for insertion into future programs. Efforts focus on the entire technical maturation spectrum, from science and technology activities through alignment to warfighter requirements, via integrated relationships in the Nuclear Security Enterprise. Weapon Technology Development works to produce multiple-system technologies and conduct exploratory studies addressing current and emerging stockpile issues and capability gaps and shortfalls, as well as to develop components replacing aging and obsolete technologies.

A.2.3.1.7 Advanced Manufacturing Development

Advanced Manufacturing Development provides early technology development efforts for non-weapon-specific programmatic investments that shorten production schedules, reduce risks, enable SNL/NM manufacturing capability, and enhance personnel safety. The program works to improve production processes and capabilities, as well as tools, fixtures, parts, and materials designed to ensure the safety, security, and performance of the nuclear weapons stockpile. It also capitalizes on new production processes for stockpile applications that improve component performance and reduce schedules, design cycles, and facility footprints while avoiding compliance issues and lowering lifecycle costs.

A.2.3.1.8 Engineering and Integrated Assessments

Radiation Effects Testing develops technologies; performs analyses; develops and validates computational models and codes; and operates facilities simulating electromagnetic and severe radiation environments to assess the performance of weapon components and systems in normal, abnormal, and hostile environments.

Material Science R&D Testing develops and applies analytical techniques to assess the structure, composition, and properties of materials. Work includes research in material behavior and performance, developing improved materials for specific components and applications, predicting lifetime performance for materials, and measuring material composition.

A.2.3.1.9 Nuclear Enterprise Assurance

Nuclear Enterprise Assurance (NEA) provides base capabilities, expertise, and other cross-cutting functions to defense programs enabling the effective implementation and execution of NEA policies and requirements. NEA accomplishes this mission by executing technical and governance activities for the assurance of systems integral to weapon systems, operational technologies directly related to weapons, and capabilities that cross-cut multiple weapons programs. NEA enables the responsible use of digital technologies in the modernization of weapons, facilities, and engineering capabilities by preventing, detecting, and mitigating the potential consequences of subversion in digital technologies, the supply chain, and other threat pathways.

A.2.3.2 Global Security Portfolio

The Global Security portfolio is aimed at protecting the Nation from strategic threats and threats from weapons of mass destruction (WMD), at home and abroad, by developing and deploying integrated technical solutions to monitor and assess emerging threats, protect materials and critical assets, and mitigate effects through rapid identification, characterization, response, and recovery.

As discussed in Sections A.2.3.2.1 through A.2.3.2.5, the Global Security portfolio has five programs: (1) Systems Mission Engineering, (2) Weapons and Force Protection, (3) Asset Security and WMD Response, (4) Monitoring Systems and Technology, and (5) Global Security and Cooperation.

A.2.3.2.1 Systems Mission Engineering Program

The Systems Mission Engineering Program provides real-time remote sensing solutions in space, ground, and other domains for actionable intelligence to counter global and national threats (Global Monitoring and Remote Sensing). Work includes development of remote sensing systems as well as large, real-time information systems that process data from various satellites. Research is conducted in data analytics and information surety. Elements of this portfolio provide service and support for the intelligence community and other government agencies:

- Advanced Systems designs, develops, and manages ground systems for real-time national security missions.
- The Space Mission group's broad technical expertise in the areas of remote sensing, space domain awareness, and space control addresses emerging national security space mission needs, including space cyber security.
- Modern System actualization works to transform sensor data into knowledge through reusable, flexible architectures for high-assurance operational environments.

A.2.3.2.2 Weapons and Force Protection Program

- The Weapons and Force Protection Program provides technologies and systems for protecting U.S. nuclear weapons and materials. The program works to counter emerging threats and resolve unique security challenges through high-consequence automation, autonomy, and robotics (Critical Asset Security). The Weapons and Force Protection Program: designs, develops, and implements advanced security systems to prevent unauthorized access, unauthorized use, theft, or sabotage to U.S. nuclear weapons or SNM;
- provides technologies and systems for protecting U.S. nuclear weapons and materials and supporting the warfighter, including the use of unmanned systems (UxS) as remote, mobile sensors and actuators to complement static sensors and assets;
- anticipates emerging threats and unique security challenges and prepares countermeasures and mitigations, including the development and deployment of portable intrusion systems for rapid response and mitigation;
- provides complete lifecycle support of systems across multiple government agencies, to include policy, planning, testing, evaluation, and design; and
- develops software and technologies for command and control, modeling, simulation, and visualization to assess the performance of physical security systems.

Within the Weapons and Force Protection Program, the Autonomy and Unmanned Systems Sub-Program develops and deploys intelligent systems to detect, characterize, and mitigate evolving threats to critical national assets, military forces, and the public. In addition, it works to address threats posed by the proliferation of UxS.⁴ Sections A.3.2.2 and A.3.4.7 of this appendix contain additional details on UxS. The Autonomy and Unmanned Systems Sub-Program:

- researches, develops, tests, and evaluates UxS performance and components (e.g., motion, material science, motor control, software, communications, electronics), and detection, tracking, and mitigation (i.e., kinetic, non-kinetic, and/or directed energy) technologies. Detection and tracking include devices such as sensors; instruments; and/or equipment that can perform radar, passive radiofrequency (RF), electro-optical/infrared, acoustic, light detection and ranging, data fusion, passive, etc. Mitigation includes non-kinetic (disruption/soft kill), kinetic (physical destruction/hard kill), and directed energy (hard kill). Non-kinetic mitigation technologies disrupt, deceive, and/or disable UxS electronics, software, and/or communications and can include RF jamming, artificial intelligence, machine learning, Global Navigation Satellite System (GNSS) jamming, spoofing (GNSS or man-in-the-middle which involves interception of communications between UxS and/or ground stations), hijacking, software attacks, etc. Kinetic mitigation

⁴ “UxS” broadly refers to unmanned aircraft systems, unmanned ground systems, unmanned underwater systems, and unmanned surface systems. A UxS consists of a comprehensive system that includes vehicle, ground control station, communication system, and payload.

uses physical forces such as nets, ammunitions, sprays, interception with other UxS including intentional physical impact/collision, etc. Directed energy includes the use of lasers, high-power microwave (HPM), and other technologies. The integration of devices and mitigation strategies such as directed energy may be from equipment on the ground or attached to and/or associated with UxS. These efforts aim to advance the science of physical security and to counter evolving autonomous threats (i.e., counter-UxS);

- operates unmanned aircraft systems (UAS) exceeding 55 pounds (lb) total upweight and exceeding speeds of 100 miles per hour (mph) at variable altitudes within the regulatory approvals from the Federal Aviation Administration (FAA) and other agencies as applicable within the national air space or restricted/prohibited airspace (including single UAS and swarms of UAS);
- includes some UAS activities that may entail controlled and uncontrolled landings due to mitigation engagement to influence the UAS causing a hard landing (uncontrolled lands will occur in disturbed areas);
- performs applied research, development, and deployment of UxS and automation; and
- develops UxS hardware and software solutions and field training to integrate, test, and perform advanced automated technologies for use by strategic partners in military surveillance, security, autonomous demilling, rescue and attack operations, and Explosive Ordnance Disposal team support and operations in high-consequence environments.

A.2.3.2.3 Asset Security and WMD Response Program

This program includes the development, assessment, and deployment of systems for critical asset protection, as well as the development of advanced technologies to prevent the use of WMDs and conduct analyses for emergency planning and response (WMD Response and Risk Mitigation). Work includes:

- WMD Counter Terrorism and Response design, development, and emergency response, with technologies, laboratory methodologies, expertise, deployable personnel, and training to assist in the prevention of, response to, and mitigation of WMD incidents (chemical, biological, aerosols, radiological, and nuclear);
- Explosive Systems and Technologies functions that provide energetic capabilities, advanced technologies, and training systems associated with national and global defense and response;
- software security solution creations to protect assets and defeat WMDs;
- Transportation Safeguards and Surety, providing safety and security assessments and solutions in high-consequence transportation settings; and
- support to the Office of Secure Transportation by designing next-generation safe and secure trailers for the nuclear stockpile for transportation.

A.2.3.2.4 Monitoring Systems and Technology Program

The Monitoring Systems and Technology Program creates systems for national security missions involving nuclear detonation detection; nuclear proliferation detection; treaty monitoring; arms control; and other needs in the diplomacy, intelligence, and military communities (Global Monitoring and Remote Sensing). Work includes development of advanced remote sensing systems to monitor worldwide activities of consequence to national security:

- Space Ground Systems leads the design, development, and delivery of the operational ground segment of the U.S. Nuclear Detonation Detection System.
- Proliferation Detection provides support to identify violations of nonproliferation and arms control treaties and agreements. It realizes remote sensing technologies and sensor systems for nuclear detonation detection through full-lifecycle design, development, production, testing, and demonstration. This sensing involves fixed and remote (mobile) field testing and application of systems to demonstrate performance.
- Weaponization and Mission Science creates and executes fundamental and applied R&D in remote sensing technologies for NNSA, DoD, the intelligence community, and SNL.
- Space Flight Systems provides research, development, test, and evaluation systems to detect and analyze remote signals from space. This group also develops satellite-borne sensor systems for space on-orbit data analysis and exploitation with supporting ground systems.

A.2.3.2.5 Global Security and Cooperation Program

The Global Security and Cooperation Program anticipates and characterizes the global security environment through research, technological development, and systems-based solutions. This program works to achieve global security through national and international technical engagement on nonproliferation, arms control, physical security, health security, and regional security topics (Counter-WMD and Nonproliferation). Activities within this program include:

- Global Engineering Security Systems that deliver innovative and sustainable security solutions to increase nuclear, radiological, and border security worldwide through the development, testing, evaluation, and implementation of security technologies and systems, along with training engagements;
- Global Chemical and Biological Security that develops and implements innovative solutions for countering global biological and chemical threats by working with global partners to prevent the misuse of dangerous chemical and biological materials; and
- Global Nuclear Security and Nonproliferation that creates technical solutions and develops partnerships to assist countries in complying with international nuclear obligations, including radiological characterization and radioactive decontamination of material and equipment used in support of nuclear compliance verification work.

A.2.3.3 National Security Programs Portfolio

The National Security Programs portfolio provides trusted, threat-informed Pathfinder technologies to DoD and the intelligence community and supports systems, science, technology, and expertise for national deterrence, defense, and security objectives. The National Security Programs portfolio includes Strategic Partnership Projects (SPPs) and Strategic Intelligence Partnership Projects.

The National Security Programs portfolio has six programs: (1) Cyber Threat, (2) Integrated Military Systems, (3) Proliferation Assessments, (4) Science and Technology Products, (5) Surveillance and Reconnaissance, and (6) Information Sciences for National Security (ISNS).

A.2.3.3.1 Cyber Threat Program

The mission of the Cyber Threat Program is to develop cyber capabilities enabling intelligence superiority and deterring adversarial aggression. Activities within this program include:

- anticipation and creation of the future in electronics, sensing, and computing, with a key focus on the exploitation of quantum technologies to improve the performance of national security systems beyond the limits of classical physics;
- Cyber Intelligence Research that conducts R&D in computer/computer network security and assessment of software vulnerabilities;
- Cyber Physical Mission that offers a deep understanding of software and hardware used in mission-critical systems and applications, with research focused on the inherent vulnerabilities from individual components to systems of systems, and that guides strategies for developing appropriate defensive measures to mitigate risks and improve the security of critical infrastructure;
- Emerging Cyber Capabilities that develop nascent, innovative cyber capabilities by synthesizing operational, experimental, threat, and vulnerability data into a complex systems understanding for the assessment and protection of high-consequence national security systems; and
- Protective Technologies that assess designs and influences national security-related information systems and technologies, focusing on microelectronics and microsystems, vulnerability assessments, and technology protection.

A.2.3.3.2 Integrated Military Systems Program

The Integrated Military Systems Program develops and demonstrates systems and technologies to defend the Nation and defeat threats to national security. Activities within this program support the integration and sustainment of operational capabilities; include research and engineering for next-generation warfighter systems; and offer design, development, and demonstration of advanced strike systems and technologies:

- Missile, Air, and Space Defense conceptualizes and demonstrates advanced technologies, delivers responsive technical solutions in anticipation of mission needs, and facilitates the integration and sustainment of operational capabilities across the broad Missile, Air, and Space Defense mission.
- Next-Gen Systems & Analysis delivers next-generation directed energy, aerospace, and other advanced military system concepts, prototypes, and components through physics-based modeling and simulation, design, development, testing, and evaluation for multi-domain dominance.
- Pathfinder Technologies performs research to prototype technologies for intelligence, perception, navigation, guidance, and control that enable next-generation autonomous warfighter systems. Through strategic partnerships, those technologies are demonstrated and deployed to strengthen military superiority.
- Missile & Systems provides rapid-response and agile system-level design, development, and demonstration of advanced strike systems and technologies to address national needs.
- Enabling Capabilities comprises a wide set of competencies intended to facilitate mission execution and collaboration with SNL's broader nuclear deterrence enterprise. Responsibilities include Mission Assurance and associated technical support, safety, security (physical and cyber), mechanical assembly and testing, nuclear deterrence aircraft compatibility test unit development, technology transfer, and systems engineering.

A.2.3.3.3 Proliferation Assessments Program

The Proliferation Assessments Program provides technical and engineering solutions that enable various federal agencies such as the U.S. intelligence community, DOE, NNSA, and DoD to assess and reduce nuclear proliferation threats. Activities within this program include analysis for the assessment of WMDs and other threats, sensing systems, and technical assessments complemented by intelligence-based analysis:

- The Threat Assessments Group specializes in technologies and analysis for the assessment of WMD threats to the United States.
- Tailored Operational Support focuses on innovative technologies, sensing systems, and technical assessments complemented by intelligence-based analysis.
- Applied Strategic Technologies focuses on specialized solutions to unique problems of strategic importance to the Nation.

A.2.3.3.4 Science and Technology Products Program

The Science and Technology Products Program is a focal point for collaborative cross-laboratory and externally sponsored (predominantly DoD) low Technology Readiness Level R&D synergies with national security program strategies. This program:

- provides independent test and evaluation services;

- develops system technologies and mission solutions; and
- researches microsystems and microelectronics, information and cyber technologies, warfighter capabilities, domain awareness, biological sciences, and physical and social sciences.

A.2.3.3.5 Surveillance and Reconnaissance Program

The Surveillance and Reconnaissance Program designs, tests, and integrates cutting-edge technology to demonstrate, field, and support high-impact surveillance and reconnaissance systems for government partners:

- Navigation Pointing and Control researches and explores conceptual designs and solutions to enable effective operations and navigation in challenged or denied environments.
- Next-Gen Communication Solutions addresses urgent and complex electromagnetic spectrum superiority challenges.
- Radar Intelligence, Surveillance, and Reconnaissance develops airborne synthetic aperture radar, ground moving target indicator, automatic target recognition, and other sensor projects for DoD, other government agencies, and industry customers.
- Secure Processing and Information Protection provides engineering for high-consequence hardware and software-based systems for government.
- Strategic Radio Frequency Systems delivers specialty sensors and high-reliability electronics for radiofrequency (RF) dominance and global communications.

A.2.3.3.6 Information Sciences for National Security Program

The ISNS Program is focused on bringing solutions in artificial intelligence and data science to national security sponsors with the goals of informing and transforming decision integrity and creating artificial intelligence advantage for the United States. By leveraging data from the sponsor's national security work, ISNS partners across SNL to solve the hardest artificial intelligence and data science challenges. The program integrates competencies in artificial intelligence, machine learning, computational analytics, human systems, cyber threat hunting, optimization, real-world data fusion, discrete-event simulation, and statistical sciences.

A.2.3.4 Advanced Science and Technology Portfolio

The Office of Science/AS&T portfolio leverages fundamental and unique scientific and engineering capabilities to support scientific priorities for DOE's missions. The portfolio supports hypothesis-driven inquiry in fundamental science to promote national security and international scientific leadership and achieves national and international impact while mitigating science and technology surprises. Capabilities include various computational science and ETFs such as bioscience laboratories, chemistry laboratories, geosciences laboratories, materials sciences laboratories, and facilities supporting plasma research and HED physics.

The AS&T portfolio has four main programs: (1) Advanced Scientific Computing Research, (2) Basic Energy Sciences (BES), (3) Biological and Environmental Research (BER), and (4) Fusion Energy Sciences.

A.2.3.4.1 Advanced Scientific Computing Research Program

The Advanced Scientific Computing Research program mission is to discover, develop, and deploy computational and networking capability to analyze, model, simulate, and predict complex phenomena. This program leads the Nation and the world in supercomputing, advanced networking, and state-of-the-art research in computer science, mathematics, and computational science.

A.2.3.4.2 Basic Energy Sciences Program

The BES Program supports fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels to provide the foundations for new energy technologies. The BES program also plans, constructs, and operates major scientific user facilities to serve researchers from universities, the National Laboratories, and private institutions. SNL/NM's core BES Program is composed of three focus areas:

- Materials Sciences and Engineering researchers investigate materials for energy systems, including work in nanomechanics and nanometallurgy, solid-state sciences, advanced atomic-level diagnostics, and materials synthesis and processing science. Core BES Materials Sciences and Engineering programs at SNL/NM include uncovering new mechanisms for entangled photon generation using novel quantum optical metasurfaces and enabling metasurface-mediated light-matter interactions in sparse quantum dot systems; using state-of-the-art capabilities in epitaxial growth, semiconductor physics, theory and simulation, micro- and nano-lithography, and spectroscopic/ultrafast characterization; and investigating grain boundaries as “living” defects whose own internal configuration and defect state evolve with external stimuli.
- Chemical Sciences, Geosciences, and Biosciences conducts experimental, theoretical, and computational research for understanding chemical transformations and energy flow in complex systems by understanding detailed fundamental processes and their interactions in multi-scale environments. Geoscience research develops molecular-level understanding of chemistry within interfacial systems.
- The CINT researchers explore the integration of nanostructures into the micro and macro worlds. Work includes experimental and theoretical exploration of nanoscale materials and structures.

A.2.3.4.3 Biological and Environmental Research Program

The BER Program supports transformative science and science facilities to achieve a predictive understanding of complex biological, earth, and environmental systems for energy as well as infrastructure security.

The program explores the biological, biogeochemical, and physical processes that span from molecular and genomics-controlled scales to the regional and global scales that govern changes in watershed dynamics, climate, and the Earth system. BER further advances the fundamental understanding of dynamic, physical, and biogeochemical processes required to systematically develop Earth system models that integrate across the atmosphere, land masses, oceans, sea ice, and subsurface. There are two divisions in this program:

- The Earth & Environmental Systems Science Division engages in research to provide a robust and scale-aware predictive understanding of terrestrial ecosystems and watersheds, which include interdependent microbial, biogeochemical, ecological, hydrological, and physical processes across spatiotemporal scales, while developing and applying high-fidelity models representing Earth system changes to improve understanding of the integrated Earth system. Major SNL/NM programs include the atmospheric radiation measurement program and the Earth System Modeling Program. This latter program includes Energy Exascale Earth System Modeling (E3SM), in which SNL/NM uses ultra-fast computing to carry out high-resolution Earth system modeling of natural, managed, and man-made systems.
- The Biological Systems Science Division performs BER for improved energy production and secure biosystems design. Starting with the genetic information encoded in organisms' genomes, BER seeks to discover the principles that guide the translation of the genetic code into the functional proteins and the metabolic and regulatory networks underlying the systems biology of plants and microbes as they respond to and modify their environments. This predictive understanding will enable design and reengineering of microbes and plants, including improved biofuels and bioproducts, improved carbon storage capabilities, and controlled biological transformation of materials. SNL/NM's biological R&D consists only of Biosafety Level (BSL) 1 and BSL-2 work. Activities and areas of research include cell culture growth, molecular cloning, protein analysis, host-pathogen interaction studies, biomarker identification, immune response studies, biological defense research, cell signaling, cell imaging, toxins research, biofuel research, limnology, ecology, and microecosystems.

A.2.3.4.4 Fusion Energy Sciences Program

The Fusion Energy Sciences Program performs research in advanced plasma science, fusion nuclear science, and fusion technology, leveraging SNL/NM's expertise and capabilities in hydrogen/tritium science, surface analysis (Ion Beam Laboratory), and detector fabrication (MESA Fabrication, Testing and Validation Capabilities). SNL/NM's expertise in fusion-relevant plasma science, plasma-material interactions, atomistic modeling, and diagnostic methods supports DOE's Fusion Energy Sciences Program, encompassing unique laboratory measurement and numerical modeling capabilities. SNL/NM's Low-Temperature Plasma Research Facility provides unique, cutting-edge optical and laser diagnostics and computational capabilities to solve challenging research problems. The SNL/NM Ion Beam Laboratory facilitates study and characterization of irradiated materials.

BSL-1 and BSL-2

BSL-1 is suitable for work involving well-characterized agents that are not known to consistently cause disease in immunocompetent adult humans and present minimal potential hazard to laboratory personnel and the environment. Laboratory personnel must have specific training in the procedures conducted in the laboratory and must be supervised by a scientist with training in microbiology or a related science.

BSL-2 builds on BSL-1. BSL-2 is suitable for work involving agents that pose moderate hazards to personnel and the environment. It differs from BSL-1 in that (1) laboratory personnel have specific training in handling pathogenic agents and are supervised by scientists who are competent in handling infectious agents and associated procedures, (2) access to the laboratory is restricted when work is being conducted, and (3) all procedures in which infectious aerosols or splashes may be created are conducted in biosafety cabinets or other physical containment equipment.

A.2.3.5 Energy and Homeland Security Portfolio

The Energy and Homeland Security portfolio secures the Nation's critical infrastructures and environment against attacks and threats by performing world-class R&D. This portfolio develops plans for energy system demonstration actions such as siting, construction, and operation. SNL/NM also partners with energy industry leaders to develop energy sources with limited environmental impacts and improve the Nation's energy infrastructure security, reliability, and efficiency. The portfolio encompasses five programs: (1) Renewable and Fossil Energy, (2) Transportation and Industrial Processes (TIP), (3) Nuclear Fuel Cycle and Grid Modernization, (4) Chemical, Biological, Radiological, and Nuclear Defense (CBRND), and (5) Homeland Infrastructure Security and Resilience.

A.2.3.5.1 Renewable and Fossil Energy Program

The Renewable and Fossil Energy Program (RFE) develops technologies that reduce cost, improve resilience and security, and expand energy options to support U.S. economic prosperity. RFE's Renewable Energy program area spans geothermal energy, hydro and marine energy, wind energy, and solar energy. SNL applies unique capabilities in high-fidelity modeling; materials development, analysis, and testing; advanced controls systems; high-temperature and high-pressure systems; cyber security; verification and validation/uncertainty quantification; subsurface access and sensing; and performance, safety, and reliability testing. RFE's Subsurface and Carbon Management program area focuses on fossil energy development; carbon management through extraction, conversion, and long-term storage; safe transportation and storage of fossil energy, including support for the Strategic Petroleum Reserve and subsurface hydrogen storage; the intersection of fossil energy and water resources; identification and remediation of abandoned wells; extraction and separation of critical minerals; and hydrogen subsurface and surface infrastructure systems. All these efforts are essential to national security, energy resiliency, and environmental stewardship. All Surface and Carbon Management R&D capabilities have parallel applications for energy security and safety, defense, intelligence work, nuclear weapons, nonproliferation, and disaster response.

A.2.3.5.2 Transportation and Industrial Processes Program

The TIP Program accelerates innovation and informs safety and security for energy-efficient manufacturing, new transportation technology, industrial decarbonization, and low-carbon

energy carriers through experimental and computational research. The TIP Program works to develop capabilities for and performs research in sustainable energy. Activities include:

- experimental investigation of combustion processes used in energy conversion to improve efficiency and reduce emissions (involves use of optical diagnostics to study fluid mechanics, heat transfer, and chemically reacting flows);
- experimental biochemical investigations and development of processes to produce valuable chemicals (e.g., fuels) from biomass and waste (includes development and characterization of algal systems for energy feedstocks and wastewater remediation);
- experimental material science investigations and development of approaches to produce, store, deliver, and use hydrogen as an energy carrier (includes safety and risk mitigation analysis);
- experiments and testing to characterize the safety of new battery materials and energy storage components;
- experimental material science and development of electric drivetrain components such as lightweight motor magnetics and high-performance ultrawide bandgap power electronics;
- modeling and analysis of distributed energy controls and security for electric vehicle charging infrastructure;
- experimental characterization of approaches to decarbonize energy-intensive industrial processes; and
- development of energy efficient microelectronic devices along with sustainable manufacturing approaches.

A.2.3.5.3 Nuclear Fuel Cycle and Grid Modernization Program

The Nuclear Fuel Cycle and Grid Modernization Program focuses on enhancing the safety, security, safeguards, and economic viability of nuclear energy; advancing the science and engineering of nuclear waste management; and developing an advanced electric grid with reliable resources and storage. Activities include:

- developing high-performance computing analytical tools to enable quicker, robust repository safety analysis;
- developing dual-purpose (storage and transportation) containers to enable the direct disposal of spent fuel to eliminate the need for repackaging;
- ensuring safe and secure long-term storage and subsequent transportation of radioactive waste through analysis of long-term fuel integrity, long-term canister corrosion, and the quantification of external loads from transportation and seismic events;
- developing advanced modeling and simulation capabilities and tools for safety, safeguards, and security analysis of both the current nuclear facilities and new advanced designs;

- developing and applying capabilities for nuclear space launch safety;
- developing physical and cyber security capabilities to protect critical nuclear energy systems, including secure cyber architectures and “secure by design” approaches to improve security and reduce risk;
- advancing risk modeling and assessment capabilities to address new technologies, environments, and threats facing the Nation’s nuclear energy, transportation, and disposal systems;
- developing and using the Nation’s premier severe accident analysis capabilities (i.e., MELCOR software and MELCOR Accident Consequence Code System [MACCS] models) and expanding the capabilities of these tools to address new systems and emerging national security needs;
- increasing supercritical carbon dioxide (CO₂) Brayton Cycle technology maturity to provide the Nation with a more efficient and sustainable technology to convert heat from nuclear, fossil, or concentrating solar power (CSP) plants to electricity.

The Grid Modernization portion of the program supports national efforts to modernize the electric grid by:

- developing transformational energy technologies and advances in power electronics and power conversion systems to allow the efficient integration of evolving grid technologies;
- analyzing the technical, economic, and national security implications of the loss or disruption of critical civilian and military energy infrastructures and options for disruption mitigation, response, and recovery;
- developing advanced diagnostic and testing capabilities for critical improvements in the safety and reliability of electric vehicles and energy storage systems;
- performing diverse energy storage research and engineering efforts ranging from basic R&D to large-scale demonstrations and deployments; and
- performing R&D in grid modeling, microgrids, distributed systems, and power electronics in support of the increased use of expanded energy.

A.2.3.5.4 Chemical, Biological, Radiological, and Nuclear Defense Program

The CBRND Program is responsible for SNL/NM’s work with various agencies to reduce the Nation’s vulnerability to chemical, biological, radiological, and nuclear threats. Bioterrorism CBRND support includes assessing bioterrorism risks; health, food, and agriculture risks; agent dispersal models; and radiological and nuclear threats while designing, developing, and deploying open architecture systems and detection capabilities to reduce threat.

Recovered weapons CBRND support includes neutralizing found, buried, and recovered chemical and biological weapons by employing capabilities in explosives engineering, mechanical design, and chemical analysis. Biosecurity CBRND support includes countering pandemics, laboratory safety, and WMDs; leveraging capabilities in digital biosecurity;

characterizing over-the-horizon threats; and conducting R&D that enables both rapid response and a secure bioeconomy. Work occurs onsite in BSL-1 and BSL-2 laboratory space.

A.2.3.5.5 Homeland Infrastructure Security and Resilience Program

The Homeland Infrastructure Security and Resilience Program is responsible for SNL/NM's work with the U.S. Department of Homeland Security (DHS) to increase the Nation's digital and physical critical infrastructure security and resilience to natural and man-made threats:

- Cyber and Critical Infrastructure Security manages and oversees cyber security efforts, bringing threat-informed expertise and information science capabilities to address cyber security threats in support of various federal agencies.
- Threats, Security, and Resilience manages and oversees work with DHS and the U.S. Department of Veteran Affairs. Work includes applied information sciences and threat-informed cyber and physical security systems capabilities to address the threat of technological surprise from evolving technologies such as computing, electronics, artificial intelligence, machine learning, wireless/communications, UAS, and other threats to U.S. critical infrastructure.

In addition to these five portfolios, there are two Special Funding Categories at SNL/NM, as follows:

- **Strategic Partnership Projects (SPPs).** SNL/NM provides technical resources and expertise to a variety of other federal agencies, the intelligence community, Special Access Programs, and non-federal entities such as state and local governments, universities, and U.S. and foreign industries through SPPs. SPPs encompass projects that are consistent with, or complementary to, DOE mission activities such as conventional defense, strategic defense, counter-proliferation and nonproliferation, treaty verification, environmental cleanup and monitoring, energy and climate, high-performance computing, safeguards and security, radiation effects, materials development and characterization, biological research, explosives research and training, law enforcement, transportation, UAS, flight/space systems, and a variety of other national security areas. SPP activities may be conducted at other federal facilities, such as military installations, National Laboratories, subcontractor facilities, universities, and private sector facilities. Examples of past SPP activities include sled track testing at Holloman Air Force Base, R&D at universities, and explosives testing activities at military installations or subcontractor locations such as the Energetic Materials Research and Testing Center near Socorro, New Mexico.
- **Laboratory Directed Research and Development (LDRD).** The LDRD program invests in financially high-risk and potentially high-payoff research that broadly enables SNL's national security missions and advances the frontiers of science and engineering. As SNL's sole source of discretionary R&D funding, the LDRD program provides the flexibility to anticipate and respond quickly to future mission needs and to explore revolutionary advances in science and technology. LDRD projects use capabilities across

SNL/NM, as well as offsite at universities and private sector laboratories and/or testing facilities.

A.2.3.6 Activities Executed for Nuclear Deterrence, Global Security, National Security, Advanced Science and Technology, and Energy and Homeland Security Portfolios Included in All Alternatives

The activities described below are executed for the NNSA mission portfolios.

A.2.3.6.1 Atmospheric and Environmental Research Modeling

Researchers conduct modeling, simulation, field measurements, and data analysis in the atmospheric, ocean, and ecohydrologic sciences. Types of activities include:

- atmospheric and ocean modeling – wildfire behavior modeling, biogeochemistry and ocean carbon cycle modeling, and climate applications to high--performance computing;
- ecology – semiarid systems ecology, soil science, carbon sequestration, and micrometeorological instrumentation and analysis;
- hydrology – surface and subsurface modeling, water resource prediction, contaminant fate and transport, and erosion;
- weapons phenomenology and infrasound – physics and chemistry of atmospheric composition, theory and modeling of electromagnetic radiation, and data analysis from satellites and ground sensors; and
- atmospheric and environmental dynamics research applications.

A.2.3.6.2 Automation and Robotics Research and Development

Researchers develop automated and robotic systems in support of stockpile stewardship and other applications. These systems increase worker productivity, reduce human exposure to hazardous situations, and minimize overall waste production. Prototypes are developed and tested in non-radiological laboratories, then transferred to radiological and non-radiological facilities. Personnel design and produce parts on a small scale, assemble and integrate mechanical and electrical components, operate and integrate systems, and test prototype instruments on non-hazardous materials. This R&D includes:

- parts design and small-scale production using hand tools and machine tools in existing laboratories and prototype fabrication labs;
- mechanical assembly and integration of robotic and other mechanical systems;
- developing, fabricating, testing (including fielding), and operating advanced robotic vehicles, including intelligent, multi-modal, and UxS;
- electrical assembly, including integration and testing of systems used; and

- system operation and integration, which includes testing algorithms and other operational issues.

A.2.3.6.3 Applied and Material Science

SNL/NM conducts a wide range of basic science related to material characteristics and behavior under varying conditions. The basic science is frequently translated into applications for industry, education, and government agencies.

This research is conducted on a wide variety of materials, including ultra-high-strength and HED, radioactive, and hazardous materials; heavy metals; gases; geological samples; ceramics; amino acids; superconductors; intermetallic compounds; and other materials of interest. Materials are characterized and modified using a wide range of techniques, such as lasers, spectrometers, x-rays, and optical devices. Materials may be shipped as needed.

Custom materials and commercial components are frequently integrated to produce new instruments or materials for specific industrial and military applications. Personnel use a variety of techniques and materials when assembling components, such as solder, alcohol, sealant, solvent flux remover, immersion oil, silicon rubber, heat sink compounds, and spray paint.

These applied and material science activities may include use of printed circuit boards, electronics equipment, and mechanical assemblies with a variety of tools and instruments used to assemble, calibrate, and test instrumentation. These include, but are not limited to, exhaust hoods, milling machines, lathes, and similar machine shop equipment.

Researchers also use a variety of general laboratory equipment such as arbitrary function generators, radiometers, signal amplifiers, image monitors, and optical light sources; high- and low-voltage power supplies; commercial and in-house fabricated charge coupled device cameras; commercial image intensifiers; radiation-generating devices; and environmental test chambers.

A.2.3.6.4 Basic and Applied Chemistry Research and Development to Support Mission Priorities

SNL/NM's basic and applied chemistry research program brings together multidisciplinary capabilities to study a wide range of topics. These capabilities include actinide and fission product chemistry, inorganic and organometallic chemistry, catalysis, surface chemistry, surface analysis, radioisotope production and distribution, chemical and electrical engineering, detection technologies, nanoscience and nanotechnology, analytical chemistry, environmental chemistry, nuclear and radiochemistry, physical chemistry, chemical and nuclear physics, and optical and vibrational spectroscopy.

A.2.3.6.5 Conventional Research and Development Laboratory Activities

Conventional laboratories are used, both at SNL/NM as well as at partnering private and public research universities and/or federal, state, and corporate/private entities across the United States, where appropriate permissions and/or agreements are in place for each location. SNL/NM

partners with laboratories that have BSL-1 through BSL-4 capabilities. Further example disciplines/areas for conventional laboratory operations may include, but are not limited to, atmospheric and environmental science; basic, applied, surface, seismic, and volcanic geology; basic, oxidation/reduction, surface, geo, applied, physical, and instrumental chemistry; bioscience; ecology; fluids, explosive, electrical, environmental, geotechnical, and chemical engineering; general science; hydrology; lasers; light, electron, and confocal microscopy; material science including characterization, shock thermodynamics, ultra-high-strength, and HED; mathematics; medical, electrical, and seismic tomography; nano and micro technologies; nuclear, chemical, geo, planetary, environmental, and atmospheric physics; optical characterization and calibration; photography; radiation effects and detectors; remote sensing, robotics including unmanned systems; and vibration suppression and structural dynamics.

Activities employ specialized locations and equipment. They include but are not limited to:

- collecting, measuring, and analyzing data from different media (air, soil, water, biological);
- soliciting, processing, analyzing, and publishing data;
- extracting, classifying, inspecting, cleaning, transforming, or modeling data;
- preparing, analyzing, and evaluating samples using various instruments;
- fabricating, modifying, testing, and verifying various sensors, products, electronics, devices, instruments, machinery, prototypes, lasers, frequencies, fluids, and other items
- developing, improving, and adapting technologies, detection limits, and portability of instruments;
- testing product and instrumentation compatibility;
- providing instrumentation support and trained professionals and recognized expertise;
- researching, testing, and developing materials, explosives, and fluids and their technologies;
- developing and preparing primary and reference standards for calibrating instruments, devices, equipment, detectors, and other items;
- performing system integration, light machining, and electronics testing, including developing semiconductors, electrochemistry, materials, and hardware and software systems;
- designing components for pulsed power capabilities;
- modeling, simulating, visualizing, and computer processing;
- attribute testing (i.e., evaluation of specific attributes or qualities resulting from laboratory tests and operations); and
- performing general laboratory activities, such as shipping samples and equipment, soldering, electrical work, weighing, purification, distillations, setting up and performing

experiments and testing, preparing standards, wet chemistry, preparing and processing samples, data recording, data research, and record keeping.

A.2.3.6.6 Electronic and Electrochemical Materials and Devices Research and Development

SNL/NM conducts research involving electrochemistry and electronic materials. Research activities include projects that involve the disciplines of chemistry, electrical engineering, electrochemistry, mathematics, materials science, and physics, which are teamed on a wide variety of projects contributing to the Nation's defense and economic security. Specific areas of research include electrochemistry and the fuel cell program, semiconductor physics research and device development, high--temperature superconductivity, electrochemical testing, general electronic materials characterization and theory, and non-destructive testing through acoustic techniques.

A.2.3.6.7 Electronic Systems Fabrication

Electronic systems are designed, developed, tested, and evaluated for industrial, academic, and federal agency applications. These systems control and communicate with many different apparatuses, such as remote handling systems, RF systems, lasers, experimental devices, surveillance equipment, alarm and safety equipment, measurement systems, and many others. Electronic systems also monitor performance, control operating parameters, serve as sensors in optics and other equipment, and perform other similar functions.

Personnel assemble electronic modules into these various systems. Electronic modules are typically obtained from a commercial vendor; however, SNL/NM conducts some design and prototyping of electronic modules in existing facilities. The control and communications systems are integrated with various apparatuses, and software is written to operate the system. System integration is often conducted at the facility contracting the work.

A.2.3.6.8 Environmental Research Activities

Environmental research at SNL/NM encompasses several different disciplines, including geology, geochemistry, and hydrology research; atmospheric, and environmental dynamics; geotechnical engineering; environmental geology and spatial analysis; geophysics; and planetary physics. Sensors are designed and tested for these disciplines, including air quality testing and geochemical, hydrological, and other research. Research includes testing of various materials for sorption properties, sample analysis, mineral and aqueous media synthesis, and chemical alteration experiments. Diagnostic instrumentation is deployed to collect data on local and regional seismic signals, acoustic/infrasound stations, near-field subsurface accelerometers, fiber optic seismic wave measurement, electromagnetic sensors, and overpressure.

A.2.3.6.9 Geology, Geochemistry, and Hydrology Research

Basic and applied geology, geochemistry, and hydrology research studies are conducted on rock, concrete, soil, parent material, and other geological samples. Research focuses on various areas,

including transport of contaminants in saturated and unsaturated hydrologic systems, carbon sequestration, basin-scale hydrology, coal technology, volcanic geology and hazards, and planetary astrobiology and geology. Research laboratory and outdoor activities are conducted. Thousands of geological samples are analyzed annually. In addition, instrumentation for conducting these studies is designed, tested, or modified.

Efforts may include siting, construction, and operation of groundwater supply or groundwater monitoring wells, or replacement wells, as well as appropriate plugging and abandonment of wells no longer needed. Wells are installed where there would be no drawdown other than in the immediate vicinity of the well and no potential to cause significant long-term decline of the water table, nor the potential to cause significant degradation of the aquifer from new or replacement wells.

A.2.3.6.10 Geotechnical Engineering Research and Development

Geotechnical research involves underground and surface geologic, seismic, volcanic, hydrologic, hydrogeologic, geophysical, and geochemical field testing; monitoring experiments; and managing samples. Past and present research has involved evaluating engineering barrier systems, coordinating field testing, and studying the potential effects of a volcanic eruption.

A.2.3.6.11 High-Temperature/High-Pressure Fluids Research and Development

SNL/NM conducts R&D projects designed to develop, test, and verify high-temperature/high-pressure fluid technologies. These technologies include hydrothermal processing, “supercritical” water oxidation, “supercritical” CO₂, and other similar technologies. When certain fluids are driven to high temperatures and pressures, in the “supercritical” region, they may be used as a gas and as a liquid.

These supercritical fluids are particularly useful as solvents. Gases, most organic molecules, and some inorganic salts are completely soluble in these supercritical fluids, and the fluids can be used for a variety of purposes, as described in the next paragraph.

SNL/NM personnel conduct basic research on the physical properties of fluids and other materials, reaction kinetics and process parameters, oxidation and reduction chemistry, and other related chemical reactions. They apply these technologies to a variety of uses, including precision cleaning, extraction of contaminants and residual solvents, chemical synthesis, polymer synthesis, chemical waste destruction (e.g., hazardous, mixed, explosives waste), semiconductor processing, chemical separations, materials modification, and other related applications.

A.2.3.6.12 Laser Science Research and Development

Small-scale R&D projects and small-scale pilot projects in the fields of basic and applied chemistry use traditional analytical instrumentation combined with lasers. Some researchers study the kinetics of chemical processes and the rates of energy transfer processes, while others develop ways to identify and/or quantify trace materials such as contaminants or small quantities of radioisotopes.

This research can be conducted in the areas of high-temperature/high-pressure fluid chemistry, materials processing and characterization, chemical kinetics, spectroscopic characterization, chemical diagnostics, and mass spectrometry diagnostics. Most of the projects are conducted in existing laboratory facilities requiring no major modifications. A few of the projects, such as remote sensing, obtain data from satellite or high-flying aircraft that operate outdoors at SNL/NM-managed lands or other locations with appropriate permissions. Outdoor work is evaluated for potential impacts to cultural and biological resources, with appropriate best management practices (BMPs) applied to prevent and/or reduce impacts.

R&D of unique lasers and their applications are also conducted as directed by sponsored clients (i.e., federal, state, and corporate/private entities). SNL/NM personnel build or modernize lasers to suit client specifications and then perform laboratory testing and verification of the laser applicability. The development of these unique lasers may involve modifications to existing lasers or a completely new design. The lasers may be used for the ultra-sensitive detection of radioisotopes. Often these projects involve joint research efforts with commercial, federal, and/or academic institutions.

Many of the projects assessed in this SWEIS involve analytical instrumentation currently used at several SNL/NM laboratories. Examples of the types of instruments that may be involved include, but are not limited to:

- inductively coupled plasma mass spectroscopy,
- radiation detectors (non-ionizing),
- gas chromatographs,
- light detection and ranging systems,
- laser ablation coupled plasma spectrometers,
- fiber optic sensors,
- near infrared communication diode laser sensors,
- Fourier transform infrared absorption spectroscopy,
- ultraviolet/visible/infrared absorption spectroscopy,
- atomic absorption spectroscopy,
- mass spectrometers, and
- magneto-optical traps.

A.2.3.6.13 Materials Research and Development, Including Characterization, Ultra-High-Strength, and High-Energy-Density

SNL/NM researchers study various materials to determine molecular structure, intrinsic defects within the material, defects introduced by the environment or radiation, thermal conductivity, thermal expansion, nuclear spin magnetization, electronic magnetization, resistance, heat capacity, and other properties. Different materials are studied, including non-metallic materials (e.g., ceramics, crystals, amino acids, polymers); transition metals; transition metal oxides; and transition and rare earth metal intermetallic compounds. These materials may be mixed compounds or layered structures, in powder or crystalline form. This research also includes developing techniques for improved sensitivity of equipment in detecting materials responses.

Samples are prepared by cutting, shaping, pressing, and grinding using wafering and wire saws, polishing tables, sonic baths, and other tools and equipment. The samples are then characterized using photon sources (e.g., mercury pen lamps, ultraviolet lights, x-ray sources, other optical equipment); fiber optic laser interferometry; nuclear magnetic resonance; and other experimental apparatus/equipment that controls environments, including cryogenic conditions and magnetic fields. Samples may be obtained from others or shipped to other facilities as needed.

SNL/NM researchers investigate, evaluate, and demonstrate new ultra-high-strength materials and very-high-energy-density materials. Ultra-high-strength materials are produced using a variety of metals (e.g., copper, silver, aluminum) encapsulated in glass, which are then heated and drawn into small wires. Thin-film samples of HED materials are synthesized under non-equilibrium conditions. Both materials are characterized by measuring the material composition, chemical structure, mechanical and thermal properties, and energy content and release of these materials.

A.2.3.6.14 Nuclear Compliance Verification

SNL/NM researchers conduct radiological characterization and radioactive decontamination of material and equipment for future reuse in support of nuclear compliance verification work on SNL/NM-managed lands and other locations with appropriate permissions in support of nuclear compliance verification work. Contamination control, equipment preservation, and waste minimization are all supported by this effort. Facilities are equipped with real-time and portable radiological monitoring equipment.

A.2.3.6.15 Optical Characterization and Calibration

Researchers characterize optical components used for a variety of applications, such as measuring solar radiation, measuring the reflectance from computer chips and wafer samples, measuring different spectral wavelengths resulting from explosives tests, measuring low-light level signals in darkened conditions, selectively measuring narrow frequencies in a light signal, monitoring motion (motion detection), and other similar light detection applications.

SNL/NM personnel measure reflectance and transmission (or absorbance) of light. Using a variety of light signals (different lamps with different wavelengths, such as visible, infrared, ultraviolet, and vacuum ultra-violet), they shine the light onto the component and use calibrated detectors and other measuring devices (such as reflectometers) to measure the reflectance or transmission of the light. This includes using low-power lasers to align the light signal onto the detector being characterized.

A.2.3.6.16 Physical Detector Research and Development

SNL/NM develops a wide variety of detectors for biological, chemical, radiological, surveillance, and reconnaissance use in physical science research capable of identifying ionizing radiation, x-rays, photons, electrical and magnetic fields, chemicals, gases, pressure, gravity, explosives, biological materials, dense materials, nano, and other phenomena. The detectors consist of a medium that responds to the primary condition of interest, such as liquid (e.g., mineral oil), solid

(e.g., crystalline materials), or gaseous (e.g., isobutane) materials, in a support housing for mechanical/electrical stability, coupled to electronic circuitry and assemblies. Activities include building, improving, and modernizing detectors, and materials characterization, fabrication, and testing of detectors.

A.2.3.6.17 Radiation Monitoring Research and Development

Researchers develop and test techniques and systems for non-destructive assay (NDA) measurements on nuclear and hazardous materials. Radiation and hazardous material monitors are also developed and tested. SNL/NM personnel conduct conceptual research, engineering, implementation, and training related to NDA measurement, instrumentation, and analysis.

Activities include designing, fabricating, building, and installing NDA instrumentation for safeguards organizations throughout the world. This work furthers the development of both active and passive techniques to more accurately measure nuclear materials. SNL/NM fabricates small mechanical parts used for these instruments/monitors or obtains parts from commercial suppliers. SNL/NM personnel design and build custom electronics and assemble, test, and develop software, and verify the detection performance of instrumentation/monitors.

A.2.3.6.18 Training Activities

SNL/NM conducts training exercises and simulations, including, but not limited to, firing-range training, force-on-force exercises, emergency response training, firefighter and rescue training, training associated with detection of radiation-generating devices, radioactive and hazardous materials, teaching/demonstrating procedures, specific training for customer needs, indoor/outdoor realistic training scenarios, and decontamination and spill cleanup training.

Training consists of instruction that includes classroom briefings, hands-on classroom training, field exercises, and demonstrations. Exercises, demonstrations, and simulations are conducted under appropriately controlled conditions and in accordance with applicable requirements. Monitors and detectors used during training conducted at SNL/NM-managed lands and other locations are operated by qualified SNL/NM personnel with appropriate training. SNL/NM personnel also provide training and expertise, including energetics, by collaborating and responding to local, state, and federal agencies' needs. Energetics activities are conducted at controlled access sites/ranges on SNL-managed lands and within the United States. Handling and storage of radiation and hazardous materials are performed in accordance with existing SNL/NM administrative operating procedures. The packaging and transportation of training materials used will follow applicable SNL/NM procedures and U.S. Department of Transportation (DOT) regulations.

SNL/NM provides training in the use of radiation detectors, instruments, and monitors to personnel from SNL, federal, state, and local agencies as well as private entities. Training may include detection of radiological devices, radioactive materials, and hazardous materials. The monitors and detectors used during training exercises include a combination of accountable radioactive sealed sources and smaller radioactive check sources for performance testing and instrument calibration.

Training may focus on vehicles, equipment, buildings, or other structures. Select trainings teach and demonstrate the procedures for locating and assessing standardized items containing radiation sources (also known as radiation-generating devices), hazardous material surrogates, or radioactive materials, including small quantities of SNM. Radiation sources may be sealed or non-sealed, and applicable control procedures are followed. Occasionally, short-lived radioactive materials may be used. Training is conducted in indoor and outdoor areas that meet safety and authorization basis criteria for the proposed training at SNL/NM and at locations within the United States. (Appropriate permissions, environmental reviews, and/or agreements are required for the locations where work occurs.)

A.2.3.6.19 Emergency Response Activities

SNL/NM personnel may be required to provide field and remote expertise to support the Nuclear Emergency Support Team. This support includes several deployable teams to meet the DOE and NNSA emergency response mission, including but not limited to the Radiological Assistance Program, Joint Technical Operations Team, Accident Response Group, Consequence Management, Disposition and Forensic Analysis Team, Stabilization Operations, and DOE Forensics Operations. These teams may be deployed within the United States and as requested by NNSA.

A.2.3.6.20 Sensor Research and Development and Testing

SNL/NM develops and conducts testing on sensitive, inertial, and fast sensors, along with imaging and measuring systems for a variety of applications, including various security and tracking systems. These sensors are also used for high-speed data acquisition and imaging that incorporate the latest in radar; laser; magnetometer; acoustic; thermal; and red, green, and blue imaging techniques. Sensor types include but are not limited to cameras, long range sensors, unattended wireless sensors, traditional Perimeter Intrusion Detection and Assessment System sensors, sonar, light detection and ranging, and seismic sensors. Researchers test and evaluate sensor technologies (free-standing, facility/fence-mounted, buried, and pole-mounted sensors) in existing or simulated facilities for physical security, including detection of intrusion by people, objects, and/or UxS on the ground and/or in the air or water.

Testing activities include but are not limited to:

- using sensors that are fabricated, modified, and/or commercial off the shelf;
- assessing, characterizing, and analyzing facility security systems;
- establishing nuisance alarm performance;
- making recommendations for improvements, including documenting vulnerability and upgrades;
- installing and replacing sensors indoors/outdoors;
- configuring and programming software and hardware systems;

- field demonstrations/exercises to test sensors including using mobile trailers with temporary generators; and
- data collection to evaluate sensor performance and effectiveness.

The demonstrations/exercises may also be shared with vendors and manufacturers of sensors/systems to provide recommendations for the improvement of products. This work is conducted on SNL-managed lands along with local, private, state, and federal facilities within the United States where appropriate permissions, environmental reviews, and/or agreements are in place. SNL/NM personnel perform work in accordance with existing SNL/NM administrative operating procedures and host facility requirements.

A.2.3.6.21 Shock Thermodynamics Applied Research

Using established techniques, SNL/NM conducts research into dynamic material properties to understand their behavior at high pressures, loading rates, and temperatures, which can be applied to virtually all materials. These techniques allow the probing of the structure of the material as it undergoes deformation. Dynamic loading experiments include the high-pressure equation of state experiments, free-flight ballistics experiments for fracture fragmentation analysis, and validation experiments for code validation.

Experiments cover a full range of pressures (bars to multi-megabars) for material property study using gas/propellant launches and ballistic applications. These activities are conducted inside. All testing is done within enclosed and evacuated chambers that are part of gas guns.

Material characterization is performed when shock waves are generated within the material to determine the equation of state at high pressures and temperature. The probing of the internal structure of the material as it undergoes dynamic loading provides an understanding of the material properties. Several materials are used, including powders, plastics, and lead.

A.2.3.6.22 Space and Atmospheric Instrumentation

Flight hardware, atmospheric instrumentation, satellite instrumentation, and small satellite systems are developed at SNL/NM. Much of this instrumentation is used for remote sensing applications, such as nonproliferation, detection of nuclear explosions, atmospheric studies, and environmental measurements. Types of instrumentation typically developed include optical and infrared remote sensing instruments; x-ray, gamma-ray, neutron, alpha particle, RF, and energetic particle instruments; astrophysical instruments for studying the atmosphere, ionosphere, magnetosphere, and solar wind; and other instrumentation for deployment on satellites or other atmospheric testing vehicles.

Outdoor experiments are often conducted as part of this research and involve measuring fluctuations in the atmosphere and ionosphere and calibrating satellite receivers that are in orbit. Outdoor experiments are conducted in and around SNL/NM-managed lands and within the Kirtland Air Force Base (KAFB) boundary and at other locations with appropriate permissions. Where appropriate, outdoor work would be evaluated for potential impacts to ecological and cultural resources, with BMPs applied if required to avoid adverse impacts.

A.2.3.6.23 X-Ray Tomography and Ultrasound Testing

SNL/NM researchers take x-rays using computed tomography (CT) and ultrasonically analyze various samples. CT equipment is used to generate three-dimensional images, detect cracks or flaws, generate three-dimensional density maps, or precisely locate parts or features within an object. Ultrasonic equipment is used to detect cracks, voids, inclusions, and density variations; as well as on samples that require small resolution inspection of surface characteristics and bulk properties. Researchers combine the x-ray CT and ultrasonic methods to determine whether data fusion techniques improve the evaluation of the sample.

A variety of samples and specimens are analyzed with this technology, including sand, soil, plastics, foam, mock explosives, composite materials, pressure vessels, or other non-radioactive samples. Researchers also analyze specimens containing naturally occurring radioactivity, such as rocks and soils. Samples come from different sources and are either shipped through traditional methods or hand-carried by entities and/or personnel requesting tests. The samples are delivered to SNL/NM and then shipped or picked up when analysis is complete. Samples containing naturally occurring radioactivity are transported according to DOT and DOE regulations.

A.2.4 SNL/NM Capabilities

This section describes the SNL/NM capabilities that support SNL/NM's portfolios and programs.

Advanced Experimental Diagnostics and Sensors. This capability refers to sensing, diagnostics, phenomenology, and signature knowledge for emerging delivery systems, qualification, experimental understanding, and Earth signatures. SNL/NM's work in this area includes R&D, prototyping, and manufacture of advanced sensor systems used for nuclear deterrence and national security programs.

Agile Component and Systems Design, Engineering, and Integration. This capability refers to the knowledge, tools, and processes underpinning agile, flexible design and manufacturing. SNL/NM is responsible for the production of NGs, microelectronics, and other non-nuclear specialty components to support limited-life component exchanges, stockpile repairs, and the LEPs and fielded system ALTs.

Simulation Codes, Models, and Data Analytics. This capability includes the computing resources necessary to support design, qualification, production, and assessment of the nuclear weapons stockpile. Simulation and computing capabilities and infrastructure at SNL/NM support activities for computer modeling and the prediction of weapon performance and material properties not accessible through experimentation, including computational surrogates for nuclear testing.

Cyber and Intelligence Science. This capability refers to SNL/NM's threat domain expertise and tools, including the human and digital dimensions. SNL/NM is working to reduce uncertainty by establishing measures of effectiveness, improving the efficiency and effectiveness of cyber experts, and increasing confidence in critical systems.

Energetic Materials and Components Science and Engineering. This capability encompasses the energetic materials domain expertise and characterization capabilities for components foundational to all modern and future nuclear weapon systems. SNL/NM uses indoor and outdoor firing sites primarily for R&D, test operations, detonator development, testing, evaluation, and production related to the nuclear stockpile LEPs and ALTs as well as support of national security programs.

Engineering Sciences and Testing. This encompasses the critical engineering sciences domain expertise addressing anticipatory assessment, design, performance, and response of current and future systems across relevant environments.

High-Performance Computing. This capability includes computing resources necessary to support design, qualification, production, and assessment. The capabilities and infrastructure related to High-Performance Computing include hardware and facilities of sufficient power to model the performance of weapon systems and components and physical processes critical to the nuclear stockpile, counterterrorism, medical countermeasures, and drug discovery, among other topics.

Materials Science and Engineering and Advanced Manufacturing. This capability encompasses integrated materials science and engineering and advanced manufacturing capabilities that support the study of how materials behave under conditions of temperature and pressure.

Microsystems R&D and Manufacturing. This capability encompasses the expertise and trusted multi-technology microsystems production capabilities enabling responsive, agile, and resilient systems. SNL/NM's work in this area includes R&D, prototyping, and manufacture of radiation-hardened microelectronics.

Physical and Biological Sciences and Engineering. This capability includes activities associated with a fundamental understanding of Earth systems that affect weapons performance, energy system resiliency, atmospheric sciences, and national security threat reduction through integrated multi-scale, multi-physics modeling and experiments.

Radiation Effects and High-Energy Density Physics. This capability includes infrastructure to support understanding and characterization of weapons physical processes (properties, thermonuclear burn, and interactions of radiation with matter) and system response to radiation and neutron environments to predict weapons performance and effects.

Synergistic Global Security Engineering. This capability includes the R&D, engineering, and maturation of technologies and Pathfinder systems that enable U.S. superiority for critical national security elements that are synergistic with the broader SNL capabilities and mission applications. SNL/NM develops large, real-time information systems that process data from multiple U.S. satellite systems and conducts research in data analytics and information surety to provide decision support systems for a broad range of federal agencies.

Weapon Component and System Surveillance and Assessment. This capability refers to the planning and execution of testing, modeling, and analysis of component and system performance.

A.2.5 SNL/NM Facilities and Infrastructure – Example Major Facilities

SNL/NM includes over 900 buildings totaling about 7 million square feet. These facilities include office space and laboratories for the myriad of SNL/NM programs. The example major existing facilities listed in Table A-1 are those that (1) have infrastructure and capabilities that are unique to the complex, (2) are representative of facilities that have potentially hazardous operations or material inventories, including all Hazard Category (HC) 2 and HC-3 nuclear facilities (DOE 2019), or (3) are related to waste management activities. Table A-1 lists these example major existing facilities and their hazard classifications at the time of writing.

Table A-1. Overview of Example Major Existing Facilities at SNL/ NM

Facility ^a	Facility Location	Industrial Facility Hazard Classification ^{b, c}	Nuclear Facility Hazard Categorization ^{b, d}
Advanced Manufacturing Processes Lab (AMPL)	TA-1	Low	Less than HC-3
Aerial Cable Facility	KAFB-East	Moderate	Less than HC-3
Annular Core Research Reactor (ACRR)	TA-V	N/A ^e	HC-2
Auxiliary Hot Cell Unit (AHCU)	TA-V	N/A ^e	HC-3
Battery Test Facility	TA-II	Low	No radiological inventory at this time *
Drop Tower Test Complex	TA-III	Low	Less than HC-3
Environmental Test Laboratory **	TA-I	Low	Less than HC-3
Explosive Components Facility (ECF)	TA-II	Low	Less than HC-3
Explosives Assembly Building	Coyote Test Field	Low	Less than HC-3
Facility for Acceptance, Calibration & Testing (FACT) Site	KAFB-East	Low	No radiological inventory at this time *

Facility ^a	Facility Location	Industrial Facility Hazard Classification ^{b, c}	Nuclear Facility Hazard Categorization ^{b, d}
Facility for Antenna and Radar Cross-Section Measurements (FARM)	KAFB-West	Low	No radiological inventory at this time *
Gamma Irradiation Facility (GIF)	TA-V	Low	Less than HC-3
Hazardous Waste Handling Unit (HWHU)	TA-III	Low	No radiological inventory at this time *
High Energy Radiation Megavolt Electron Source (HERMES) III	TA-IV	Accelerator	Less than HC-3
Ion Beam Laboratory	TA-I	Low	Less than HC-3
Light-Initiated High Explosive Facility (LIHE)	TA-III	Low	Less than HC-3
Lurance Canyon Burn Site	KAFB-East	Low	No radiological inventory at this time *
Mechanical Shock Complex (also known as Dynamic Shock Facility)	TA-III	Low	Less than HC-3
Microsystems Engineering, Science and Applications (MESA) Complex	TA-I	Moderate	No radiological inventory at this time *
National Solar Thermal Test Facility (NSTTF)	KAFB-West	Low	No radiological inventory at this time *
Neutron Generator Enterprise+ (NGE+)	TA-I	Low	Less than HC-3
Power Sources Technology Group Capabilities **	TA-I	Low	No radiological inventory at this time *
Radioactive and Mixed Waste Management Unit (RMWMU)	TA-III	Low	Less than HC-3
Rocket Sled Test Complex	TA-III	Moderate	Less than HC-3

Facility ^a	Facility Location	Industrial Facility Hazard Classification ^{b, c}	Nuclear Facility Hazard Categorization ^{b, d}
Sandia Pulsed Reactor (SPR) Facility	TA-V	N/A ^e	HC-2
Saturn Accelerator	TA-IV	Low	Less than HC-3
Shock Thermodynamics Applied Research Facility (STAR)	Coyote Test Field	Low	Less than HC-3
Site 9920	Coyote Test Field	Low	Less than HC-3
Site 9930/9939	Coyote Test Field	9930 and 9939 = Low	9930 and 9939 = Less than HC-3
Site 9940	Coyote Test Field	Low	Less than HC-3
Site 9990	Coyote Test Field	Low	No radiological inventory at this time *
Solid Waste Collection and Recycling Center ^f	TA-II	Low	Less than HC-3
Strategic Defense Facility	TA-IV	Low	Less than HC-3
Superfuge Complex	TA-III	Low	Less than HC-3
Terminal Ballistics Facility	TA-III	Low	Less than HC-3
Thermal Test Complex	TA-III	Low	Less than HC-3
Thermal Treatment Unit (TTU)	TA-III	Low	No radiological inventory at this time *
Thunder Range	Coyote Test Field	Low	Less than HC-3
Z-Machine	TA-IV	Low	Less than HC-3

* At time of writing, the facility would have to update documentation to work with radiological inventory, within Resource Conservation and Recovery Act (RCRA) permit requirements.

** Work for this capability uses only portions of the hosting buildings.

- a. All facilities have other potential hazards mitigated by appropriate controls and regulations, including biological materials, beryllium, standard chemical storage, explosives, hazardous waste collection, accelerators, x-ray machines, lasers (including Class 3b and 4 lasers), electrical, and collection and storage of compressed gas cylinders.
- b. Categories (Industrial Facility Hazard Classification and Nuclear Facility Hazard Categorization) represent the designation at the time of writing and could change with appropriate documentation and permissions.
- c. Industrial Facility Hazard Classification is part of the Safety Basis process. The consequences of unmitigated hazards are evaluated as required by Integrated Safety Management and the SNL/DOE Non-Nuclear Safety Basis Framework, which are implemented through Safety Basis chapters in the Environment, Safety, and Health Manual (SNL 2024a; SNL 2024b; SNL 2024c; and SNL 2024d). Industrial facilities are classified into the following levels based on potential impacts to receptors: (1) High (Offsite): The analysis of hazards shows the potential for significant offsite consequences from unmitigated hazards; (2) Moderate (Onsite): The analysis of hazards shows the potential for significant onsite consequences from unmitigated hazards; and (3) Low (Local): The analysis of hazards shows the potential for significant only localized worker consequences from unmitigated hazards.
- d. Nuclear Facility Hazard Classification is part of the Safety Basis process. The consequences of unmitigated releases of radioactive materials are evaluated as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 830, and DOE-STD-1027-92, 92, Change Notice No. 1 (DOE 1997c), defines and categorizes the radiological

hazards of DOE/NNSA nuclear facilities. An HC-1 facility has a potential for significant offsite consequences; an HC-2 facility has a potential for significant onsite consequences beyond localized consequences; an HC-3 facility has a potential for only local significant consequences; and a Below HC-3 facility (also referred to as a “Less than HC-3 Facility”) has a potential for only consequences less than those that provide a basis for categorization as an HC-1, HC-2, or HC-3 nuclear facility.

- e. N/A: Non-applicable; facilities with an HC-1, HC-2, or HC-3 nuclear designation cannot also have an Industrial Facility Hazard Classification.

A.2.5.1 Advanced Manufacturing Processes Lab

The Advanced Manufacturing Processes Lab (AMPL) supports development and application of manufacturing technology to engineering products for national security missions. AMPL, which consists of about 76 laboratories and more than 136,400 square feet of floor space, can engineer prototypes and perform limited manufacturing of many specialized components for nuclear weapons. The manufacturing technology development in AMPL focuses on enhancing capabilities in broad areas, including manufacturing of engineering hardware, production of emergency and routine weapon hardware, development of robust manufacturing processes, and design and fabrication of production equipment.

A.2.5.2 Aerial Cable Facility

The Aerial Cable Facility (ACF) provides simulation capabilities for a variety of impact and other environments, including gravity drop, rocket pull-down, aerial trolley, and explosives tests. The facility has four primary cable systems that span two ridges over a mountain canyon. Each cable is about 5,000 feet (~1,500 meters) long. At the center of each cable span is a flat test arena about 300 feet (~90 meters) in diameter. The facility uses data acquisition systems, telemetry, and onboard data recorders to gather data from a variety of instruments and transducers, along with photometrics to make independent, non-contact measurements. The facility can perform a variety of testing that offers:

- pulldown tests,
- high or low velocity,
- guided and unguided drop testing,
- hard or soft targets,
- penetration events,
- items containing radioactive materials,
- explosives (including test unit main charge),
- intentional explosive detonation site,
- rocket rail, and
- trolley and simulated free flight.

A.2.5.3 Annular Core Research Reactor

The ACRR facility, located in TA-V, provides neutron and gamma radiation environments in either pulsed or sustained operation modes for experiments, including testing weapons components and reactor safety research. The ACRR is a research reactor facility capable of performing:

- tests of neutron effects on weapon/fissile components,
- tests of radiation effects on various types of electronics,
- neutron radiography, and
- tests of radiation effects on materials and systems.

The reactor core is in an open pool that contains deionized water. The core is cooled by natural convection using a bulk coolant tank to maintain water volume in the reactor vessel. The bulk water can be cooled using a cooling tower and associated fans to maintain the pool water near ambient temperature. The ACRR Facility is a National Emission Standards for Hazardous Air Pollutants (NESHAP)-monitored facility and an HC-2 nuclear facility. As noted in Chapter 3, Section 3.4.2, of this SWEIS the proposed Combined Radiation Environments for Survivability Testing (CREST) Complex would provide an enhanced replacement facility for the ACRR.

A.2.5.4 Auxiliary Hot Cell Unit

The Auxiliary Hot Cell Unit (AHCU), (also known as the Auxiliary Hot Cell Facility in safety basis documentation), located in TA-V, is used for sorting and repackaging of nuclear material and waste for permanent removal from the SNL/NM site. The AHCU is designed to provide the capabilities, equipment, and hazard controls necessary to safely handle and temporarily store highly radioactive material. The AHCU is an HC-3 Resource Conservation and Recovery Act (RCRA) storage and a NESHAP-monitored facility. This facility had small quantities of tritium emissions in 2022.

A.2.5.5 Battery Test Facility

The Battery Test Facility, located in TA-II, is used for the basic handling and storage of power sources, battery fabrication, preparation of power sources for testing, and non-abuse testing of the power sources. Capabilities include specially designed hazardous materials storage units and local exhaust ventilation integrated with gas sensor equipment to detect and manage off-normal events.

A.2.5.6 Drop Tower Test Complex

The Drop Tower/Water Impact Test Complex, located in TA-III, is used for studies of hard surface and ice penetration impacts, water surface impacts, underwater submersion, and underwater explosive effects. The complex consists of a 185-foot drop tower, a 300-foot drop tower, and a man-made lake. The complex is used to drop heavy items for free-fall vertical or combined vertical and horizontal velocity drop tests onto various types of targets.

A.2.5.7 Environmental Test Laboratory

The Environmental Test Laboratory in TA-I supports development, qualification and acceptance testing, model validation experiments, and weapon component and hardware evaluation. The facility provides research, development, and analysis and testing/experimental applications expertise in solid mechanics, shock physics, and structural dynamics. Testing labs include modal and structural/component dynamics, radiography, mechanical shock, experimental impact

mechanics, climatic testing, vibration testing, centrifuge testing, non-destructive evaluation (ultrasonics), structural mechanics, and radiological/explosives storage and handling.

A.2.5.8 Explosive Components Facility

The Explosive Components Facility (ECF) in TA-II conducts R&D on a variety of energetic material and explosive components in support of the nuclear weapons mission, other NNSA national security missions, and projects for other customers. The facility consists of a main building, six explosives storage magazines, and a storage building. The ECF has indoor chambers and blast pads certified for indoor testing of explosives from micrograms up to 1 kilogram (kg) trinitrotoluene (TNT) blast equivalent. The ECF is a NESHAP-monitored facility with operations that could result in the release of trace amounts of tritium. The following activities are performed at the ECF:

- physical and chemical characterization and testing of explosives, pyrotechnics, and propellant materials for advancing energetic material science and technologies;
- design and development of advanced explosive components;
- production of energetic materials and components;
- stockpile surveillance of explosives, pyrotechnics, and propellants;
- development of novel diagnostics and detectors for energetic material;
- research, development, and testing of neutron-generating devices;
- physical testing of batteries;
- maintaining explosives storage magazines and storage buildings; and
- use of sealed radioactive sources, x-rays, and laser technologies for R&D activities.

A.2.5.9 Explosives Assembly Building

The Explosives Assembly Building is located in Coyote Test Field (CTF) and provides remote operations (e.g., machining, sawing, contact cutting) on explosives and components evaluated in the ECF. Operations include machining raw explosives, assembling and disassembling explosive components and subsystems, and pressing high-density pellets from explosive powders.

A.2.5.10 Facility for Acceptance, Calibration & Testing Site

The SNL/NM Facility for Acceptance, Calibration & Testing (FACT) Site, located in KAFB-West and KAFB-East along the KAFB southern boundary, conducts evaluations and is employed to make recommendations of geophysical instrumentation used in monitoring systems for the detection of nuclear explosions. The capabilities at the SNL/NM FACT Site directly support nuclear nonproliferation missions, both nationally and internationally, working with U.S. monitoring agencies. The FACT Site is located remotely to balance the competing needs for accessibility by SNL/NM staff and isolation from ambient and human--caused noise sources.

A.2.5.11 Facility for Antenna and Radar Cross-Section Measurements

The Facility for Antenna and Radar Cross-Section Measurements (FARM), located in KAFB-West, is an antenna/radar cross-section measurement facility. Activities include measuring antenna patterns at RFs across the electromagnetic spectrum and the radar cross-section of objects. The facility also includes an electromagnetic shielded room used for fabrication and testing of RF and microwave circuits and equipment. Outdoor activities include use and testing of various RF-generating equipment for aircraft flyover detection testing.

A.2.5.12 Gamma Irradiation Facility

The Gamma Irradiation Facility (GIF), located in TA-V, provides a single structure for performing a wide variety of gamma irradiation experiments with various test configurations and at widely varying radiation dose and dose rate levels. The GIF is divided into three types of irradiation facilities (in-cell dry, in-pool wet, and low-energy dry) based on the type of test to be performed. Areas of application include:

- thermal and radiation effects studies,
- degradation testing of weapon components,
- material and component testing for nuclear reactor accident tests,
- electronic component certification and testing,
- survivability and certification tests for military and commercial applications,
- research on radiation effects on material properties and organic materials, and
- mixed environment testing (including steam and radiation or heat and radiation).

The GIF has a separate pool used for underwater testing and simulation of radiological facilities. However, no radioactive material is placed in this pool. Because of its large size, the GIF high bay is also used to support other activities in TA-V.

A.2.5.13 High Energy Radiation Megavolt Electron Source III

The High Energy Radiation Megavolt Electron Source (HERMES) III, located in TA-IV, is a short-pulse (20- to 30-nanosecond), high-energy (20-megaelectronvolt) accelerator that provides intense x-ray and neutron fields over very large areas. These fields enable testing under conditions similar to some aspects of a nuclear explosion radiation environment. The radiation can be used to test the response of electronics and weapon system components. HERMES III can also be reconfigured to accelerate light positively charged atomic nuclei. The facility includes the accelerator, an indoor exposure (test) cell, and an outdoor exposure area. Experiments performed using the HERMES outdoor test cell may include non-ionizing radiation in addition to x-ray radiation. HERMES is a NESHAP-monitored facility. There are two 250,000-gallon mineral oil storage tanks with secondary containment to catch any inadvertent loss of oil at HERMES III.

A.2.5.14 Ion Beam Laboratory

The Ion Beam Laboratory, located in TA-I, supports the performance of basic and applied research and the establishment of theories and models in the areas of materials science, radiation

effects, solid-state physics, and accelerator physics. The facility includes a laboratory with high-density concrete shielding for use with high-radiation experiments. Equipment at the facility accelerates ions to analyze composition, modify, or better understand the nature of materials and to study material defects and their effects. The Ion Beam Laboratory is a NESHAP-monitored facility. Some activities at the laboratory involve the use of tritium targets, which can off-gas elemental tritium during use. The off-gassed tritium exits the laboratory building through its ventilation exhaust.

A.2.5.15 Light-Initiated High Explosive Facility and Thermal Treatment Unit

The Light-Initiated High Explosive (LIHE) Facility, located in TA-III, is designed to give an external shock to a target item. The LIHE Facility has specialized equipment and processes designed to formulate and remotely spray deposit light-sensitive primary explosives onto objects. A flash of bright light initiates the explosive detonation. High-speed diagnostic instrumentation and radiographic instrumentation collect data from the testing. Small-scale explosives tests are also conducted at the LIHE Facility. The Thermal Treatment Unit (TTU) was built adjacent to the LIHE Facility to provide onsite treatment for explosive waste generated at the LIHE Facility.

A.2.5.16 Lurance Canyon Burn Site

The Lurance Canyon Burn Site is specifically designed for validation of analytical modeling and functional certification of weapons systems. The Lurance Canyon Burn Site is also used to test and evaluate the design integrity and performance of weapon components and shipping containers in the event of accidental exposure to various fires. Aviation fuel fire tests are conducted at a combination of indoor and outdoor test facilities at the Lurance Canyon Burn Site. All indoor tests are performed under controlled conditions, based on test specifications, and provide emission controls when required. The Lurance Canyon Burn Site is one of SNL/NM's intentional detonation sites, and it hosts tests involving energetic materials, including solid rocket propellant and explosives, conducted in an outdoor test facility that uses wood fires, crib fires, propane, and jet A fuel for certifying DOT explosive component shipping containers. The facility consists of an outdoor pool used for conducting open burn tests, an indoor flame facility, and an igloo for indoor testing.

A.2.5.17 Mechanical Shock Facility (also known as Dynamic Shock Facility)

The Mechanical Shock Facility, located in TA-III, is used to create controlled impact and shock environments produced by transportation, flight, impact, explosion, and other dynamic events. The main tools at the Mechanical Shock Facility include an indoor sled track driven by a pneumatic actuator, a pneumatic gas gun, and mass properties tables used to measure mass, center of gravity, moment of inertia, and product of inertia.

A.2.5.18 Microsystems Engineering, Science and Applications Complex

The MESA Complex in TA-I is a set of co-located facilities for the research, development, prototyping, and manufacture of radiation-hardened microelectronics. The MESA Complex is a

NESHAP-monitored facility, although there is no radiological inventory in the facility at this time. Areas of expertise in the MESA Complex include:

- radiation-hardened electronics and trusted systems,
- fabrication, testing, and validation,
- National Security Photonics Center,
- quantum systems,
- sensors,
- microelectromechanical systems, and
- power electronics.

Research and analyses, as well as computer modeling, facilitate the following activities at the MESA Complex: microsystem integration, failure analysis and reliability physics, modeling and simulation, component engineering, testing, and RF and photonics.

A.2.5.19 National Solar Thermal Test Facility

The National Solar Thermal Test Facility (NSTTF) (Figure A-3) provides experimental engineering data for the design, construction, and operation of unique components and systems from prototypes to large scales. These components and systems are used in proposed solar thermal applications planned for producing and storing energy and generating process heat. The facility location was specifically selected based on the optimal solar days inherent in the geographic region, proximity to existing solar research, and appropriate set-backs from other test locations. The NSTTF is the only test facility of this type in the United States and was built and instrumented to provide test facilities for a variety of solar and non-solar applications. Its mission is to aid the concentrated solar thermal industry to succeed in the areas of power production, energy storage, and industrial decarbonization. The NSTTF serves as the test resource for the DOE program to develop concentrated solar power and as a designated user facility available for use by other researchers, including federal agencies and contractors, research institutes, universities, and private companies. The site is also used to test other energy conversion

technologies (including those involving photovoltaic [PV] cells and wave energy conversion). The Generation 3 Particle Pilot Plant (G3P3) is under construction and will be a high-temperature, particle-based system for concentrated solar power.



Figure A-3. NSTTF

A.2.5.20 Neutron Generator Enterprise+

Production of NGs, which occurs at the Neutron Generator Enterprise+ (NGE+), mainly in TA--I, involves fabricating and assembling major components such as neutron tubes, power supplies, and timers. Fabricating activities include three-dimensional metal printing, laser cutting, acid washing, hydrogen furnaces, soldering, high-voltage testing, and related assembly processes. The potential for tritium emissions exists at various process steps, including equipment calibration, destructive testing, process monitoring, and material handling. The facility has two stacks, but only the main stack in the Tritium Envelope North Wing is used. Although anticipated tritium releases do not exceed the regulatory threshold that requires continuous monitoring, monitoring is performed voluntarily at the facility as a BMP. Sealed radioactive sources, non-destructive testing (x-rays), and lasers are used in the process. Some components are fabricated using lead oxide. The NGE+ is a NESHAP-monitored facility.

A.2.5.21 Power Sources Technology Group Capabilities

The Power Sources Technology Group Capabilities, currently in TA-I, will be moved and consolidated into a new Power Sources Capability facility in TA-II. The new facility will provide the necessary infrastructure and facilities designed to current safety, security, and quality requirements to conduct full lifecycle operations of R&D, design, production, and surveillance of a variety of power sources in support of the nuclear deterrence mission, other NNSA and DOE missions, and other customers. This capability requires a variety of space types, including chemistry, testing, assembly, dry room, and cleanroom laboratories; storage capabilities for hazardous materials and product; and offices. The following activities are being consolidated:

- R&D activities (including material development, characterization, and testing; designing, prototyping, and testing of new technologies; and development of characterization and evaluation methods);
- design activities (including developing, fabricating, and testing power sources and components; integration with systems; and development of new testing methods, testers, and hardware);
- production of power source components;
- surveillance of power source components (including long-term storage, aging, inspection, testing, and disassembly activities); and
- core capabilities (including basic storage and handling of materials and power sources; shipping and receiving; and other general laboratory and operational functions).

A.2.5.22 Rocket Sled Test Complex

The Rocket Sled Test Complex in TA-III simulates a variety of environments, including acceleration, aerodynamics, and high-velocity impact in a controlled manner. Most tests are done to support the Stockpile Stewardship and Management Program. The Rocket Sled Test Complex consists of several buildings, support structures, two sled tracks (10,000 feet and 2,000 feet long), four explosives test pads, and blast tubes (also known as “shock tubes”) used to test various explosives, rocket motors, and test units. This moderate-hazard facility can support test unit hazards that include some or all of the following:

- explosives (including test unit main charges),
- intentional explosive detonation sites,
- radioactive materials,
- beryllium,
- fires,
- rocket motors,
- x-ray imaging, and
- many other hazards.

A.2.5.23 Sandia Pulsed Reactor

The Sandia Pulsed Reactor (SPR) is located in TA-V. The Sandia Pulsed Reactor Facility-Critical Experiments (SPR/CX) is located within the SPR. The SPR/CX is a small reactor vessel with an attached demineralized water tank that fills the vessel. The SPR/CX is a flexible experiment platform used for a series of low-energy, critical-assembly experiments. Activities at SPR/CX include investigating the effects of fission product poisons on nuclear systems and providing data for testing reactor physics design methods used to design commercial nuclear power reactor fuel assemblies. In addition to SPR/CX, the SPR uses small, sealed radioactive sources for calibrating and monitoring in the reactor building. The SPR is also used to receive, store, and ship radioactive material and waste, as well as experiment materials. The SPR is used

to provide hands-on nuclear criticality safety training—taking advantage of the SPR/CX platform. The SPR is an HC-2 nuclear facility.

A.2.5.24 Saturn Accelerator

The Saturn Accelerator (Figure A-4) located in TA-IV, supports development and survivability testing of nuclear weapon subsystems and components. The accelerator is a symmetric, parallel-current driver consisting of 36 identical pulse-compression and power-flow modules arranged like the spokes of a wheel. Activities in the Saturn Accelerator involve testing the survivability of nuclear weapon systems by simulating the effects of nuclear countermeasures on electronic and material components and providing a diagnostic test bed for accelerator component development. There are two 250,000-gallon mineral oil storage tanks with secondary containment to catch any inadvertent loss of oil at the Saturn Accelerator.

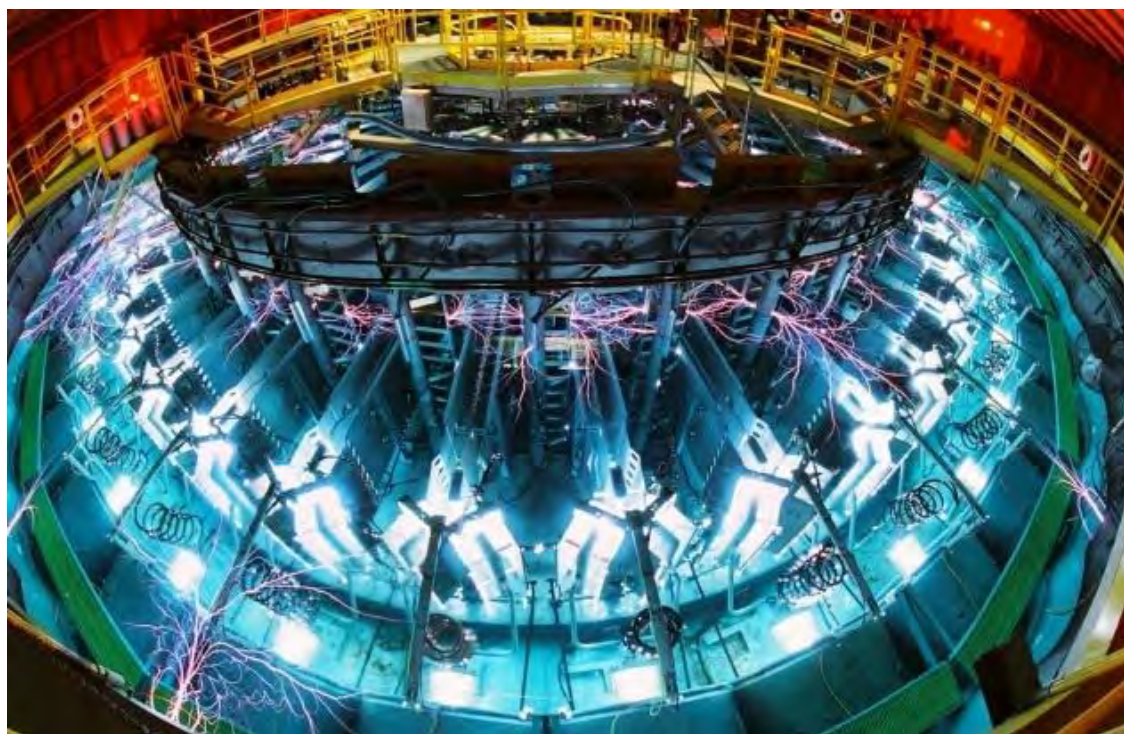


Figure A-4. Saturn Accelerator

A.2.5.25 Shock Thermodynamics Applied Research Facility

The Shock Thermodynamics Applied Research (STAR) Facility, located in CTF, is a laboratory for comprehensive dynamic material characterization and ballistic studies using shock compression. The major objective of shock compression is to determine material properties over a sufficiently large range of loading conditions for the purpose of developing theories of material response for use in computer modeling codes. The facility consists of five different laboratory launchers, or gas guns, that accelerate projectiles with either propellant or helium gas.

Additionally, energetics, such as primers and smokeless powder, are used in the firing of the guns.

A.2.5.26 Site 9920

The 9920 Complex (37 acres) includes buildings, bunkers, trailers, an air building, and other equipment. The 9920 Complex capabilities include multiple outdoor testing arenas and indoor explosives test areas. Activities at 9920 include vehicle and industrial equipment use, site maintenance, energetic material storage, training, testing, and explosives R&D involving explosives tests up to 100 lb net explosive weight (NEW). Specific training and testing activities at 9920 include Percussion Actuated Neutralizer training, which is an explosive ordnance disposal tool designed to render improvised explosive devices safe; polyfluoroalkyl substances (PFAS)-free aqueous foam testing; particulate aerosol sampling; and testing indoor detonation of novel nuclear reactor fuels, such as small amounts of natural or enriched uranium.

A.2.5.27 Site 9930 and 9939

The 9930 Complex includes Site 9930 (79 acres) and Site 9939 (30 acres), which have buildings and supporting bunkers, trailers, and transportainers, as well as testing arenas for explosives tests up to 50 lb NEW. Activities at the 9930 Complex include ongoing and routine training, testing, and energetic R&D activities involving explosives tests. Energetically configured UAS R&D exercises occur at a sited explosives range in an outdoor enclosed flight cage made with concrete blocks and secure netting to keep UAS inside of an enclosed environment, so that it remains out of FAA-controlled airspace.

A.2.5.28 Site 9940

The 9940 Complex, located in CTF, has buildings and supporting bunkers, trailers, and transportainers, as well as explosives ranges for explosive tests up to 50 lb NEW. Activities at 9940 include creation of real-world threat scenarios that meet first responder training mission objectives to prevent and mitigate nuclear threats. Explosives training for DoD, DOE, and the U.S. Department of Justice is also conducted. Sealed and non-sealed radiological sources and materials are used in training and research. Several field training venues are available or can be constructed at 9940, including:

- sewer/underground facilities,
- storage shed-type buildings,
- shipping container stack and venues,
- construction site trailers,
- semi-trailers and vehicles,
- pile of construction material, and
- simulated villages, temporary holes, arcades, assorted containers, and real-life scenarios.

A.2.5.29 Site 9990

The 9990 Complex conducts R&D, testing, and training, including laboratory, indoor and outdoor fabrication and assembly, and field testing and exercises. The site maintains two active explosives storage bunkers. Radiological materials (sealed) owned by SNL/NM and other government agencies may be used in testing and training activities. Facilities maintenance and testing activities may also include ground disturbances, chemicals, lasers, low- and high-voltage components, heavy equipment and vehicle usage, radiation--generating devices, and thermal operations.

A.2.5.30 Strategic Defense Facility

The Strategic Defense Facility in TA-IV is made up of two buildings containing various light electronics and electromechanical laboratories and rocket and flight vehicle assembly areas. Operations are related to the design, development, assembly, manufacture, and testing of hardware, software, and data acquisition systems for the advancement of radiation and electrical sciences and applications. The work performed in these laboratories consists of electrical components design, development and testing, soldering, electromechanical assembly and disassembly, laser etching, and highly accelerated stress testing. Additionally, explosives and stored energy articles are built in this facility.

Equipment in use includes environmental chambers using nitrogen and argon, highly accelerated stress testing chambers, ovens, power device analyzers, dry storage nitrogen chambers, and temperature forcing units. These laboratories also use lasers, including Class 3b and Class 4 laser etching equipment. High bay cranes, springs, small explosive charges, pressurized gas, battery systems, and other items are used for the rocket hardware builds.

A.2.5.31 Superfuge Complex

The Superfuge Complex in TA-III simulates launch and atmospheric reentry environments, aircraft maneuvering accelerations, crash and impact decelerations, and other acceleration environments. Activities at the complex include combined inertial testing (vibration, thermal, axial spin) on customer payloads, which could include explosive or radioactive contents. The Superfuge Complex consists of two large centrifuges driven by a common hydraulic power supply, a 29-foot indoor centrifuge, and a 35-foot centrifuge located outdoors with a concrete-lined earth berm surrounding it. At both centrifuges, lighter test items may be accelerated further. As discussed in Chapter 3, an additional new centrifuge is proposed.

A.2.5.32 Terminal Ballistics Facility

The Terminal Ballistics Facility in TA-III is a series of indoor and outdoor test facilities, which support a variety of small- and large-scale explosives testing for mission needs. The facility houses office space, a control area, and an indoor ballistics range. Associated buildings surrounding the complex are used for explosives storage, general storage, and other mission-related pyrotechnic activities. Outdoor test capabilities include:

- large-caliber gun range with various artillery guns;
- various outdoor ranges for detonating explosives to characterize and analyze effects – explosives detonated may include radioactive materials such as depleted uranium;
- static-fire rocket stands used to measure the thrust force of small rockets;
- test environments for ballistic studies; and
- minefield used for improvised explosive device, counterterrorism, and similar mission-related work for others.

A.2.5.33 Thermal Test Complex

The Thermal Test Complex, located in TA-III, provides a controlled environment to evaluate weapons safety in abnormal thermal environments.

Thermal Test Complex facilities include:

- Fire Laboratory for Accreditation of Modeling by Experiment (FLAME) test cell – simulates low-wind outdoor fires and utilizes advanced optical diagnostics;
- Crosswind Test Facility (XTF) – performs fire, radiant heat, and pressurization tests on weapons systems and components;
- radiant heat test cell – performs high--temperature simulated fire tests; and
- abnormal thermal environments laboratory – performs small-scale fire and radiant heat tests.

A.2.5.34 Thunder Range

Thunder Range, located in CTF, includes explosives ranges (sited up to 2,000 lb NEW), bunkers, trailers, and other workshop, laboratory, and training spaces. Activities at Thunder Range include training, testing, and energetic materials R&D activities, as well as fielding of advanced explosive tools for explosive ordnance disposal uses, energetic breaching, and critical national missions. It is a training venue for the national nuclear emergency response community. Examples of testing include powder gun testing, tool development, energetic use training, and improvised explosive device testing.

Shallow subsurface munitions testing takes place at Thunder Range, with explosives tests maintained within sited range limits. Test shots involve explosive charges that are buried up to 20 feet below ground surface (ft-bgs).

A.2.5.35 Z-Machine

The Z-machine in TA-IV is a powerful electrical device, radiation source, and pulsed power facility. Activities at the Z-machine (Figure A-5) include high-pressure material science, cold and warm x-rays for hostile survivability studies, magnetic direct drive fusion, radiation transport in highly ionized materials, and HED physics for stockpile stewardship. Data from the

Z-machine is used to validate HED physics models for the safety, security, and effectiveness of the stockpile and to evaluate the survivability of weapons in hostile radiation environments.

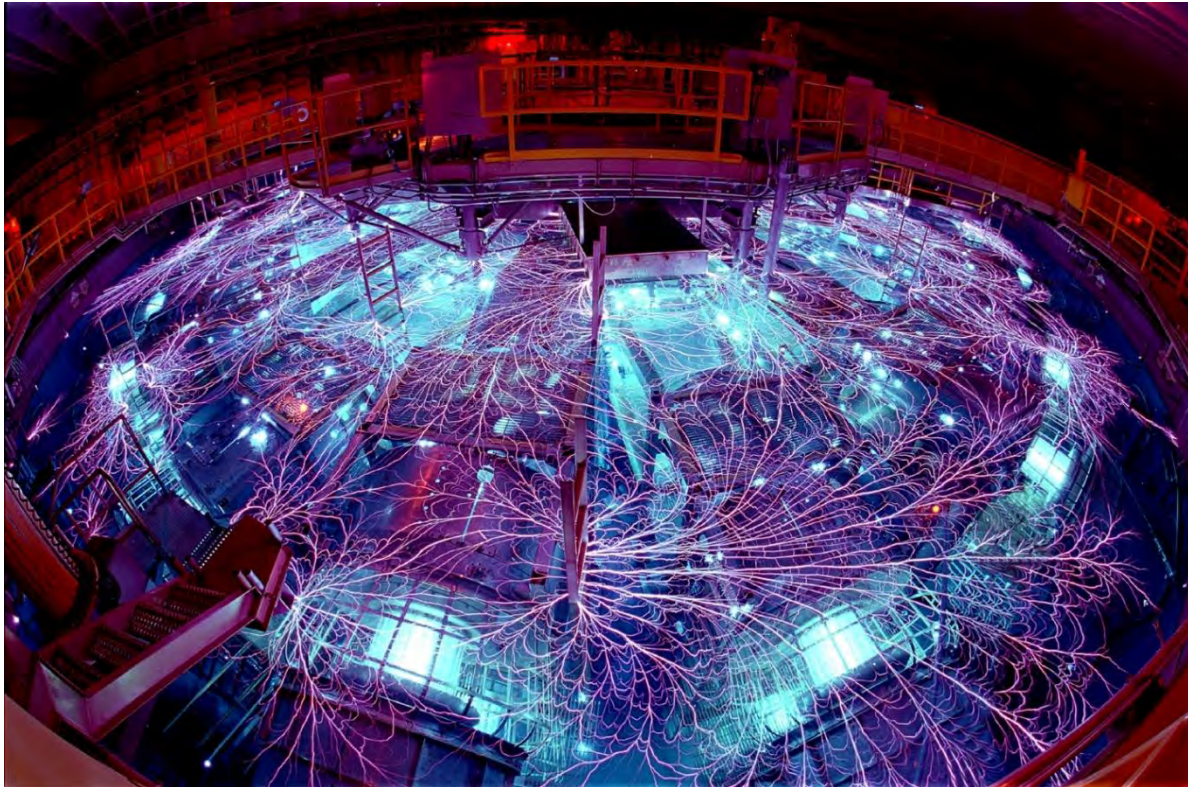


Figure A-5. Z-Machine

SNM is used at the Z-machine. The following are relevant attributes of the Z-machine:

- Experiments could use small amounts of tritium or small amounts of actinides and hazardous materials such as uranium, plutonium, and beryllium. Sulfur hexafluoride (SF₆) gas is used at the Z-machine on various high-voltage switching devices. The Z-machine is a NESHAP-monitored facility, and some experiments could result in the release of trace amounts of radionuclides such as tritium, as well as non-radiological hazards such as beryllium.
- High-energy, high-power laser systems are used for HED science experiments and diagnostic development.
- Large quantities of mineral oil surround the outer region of the Z-machine to insulate high-voltage energy storage components, while the mid-region is filled with deionized water to insulate high-voltage transmission lines.
- Three 250,000-gallon-capacity tanks and one 150,000-gallon-capacity tank are built in place to contain this oil when it is pumped away from the Z-machine. These large oil storage tanks have appropriate secondary containment and inspection and maintenance to prevent unintentional loss of stored oil.

- Scientists use the Z-machine to study the behavior of stockpile materials at greater than 1 millibar pressure. Measurements inform and differentiate between models used to simulate the performance of the U.S. stockpile. SNL/NM collaborates with Los Alamos National Laboratory (LANL) to conduct Post-Experiment Unirradiated Plutonium Isentropic Compression Experiments (Pu-ICE) in the Z-machine to verify the reliability of the nation's nuclear stockpile.
- Experiments on the Z-machine support the understanding of cold x-ray effects on aeroshells that surround the warhead and warm x-ray effects that cause system-generated electromagnetic pulse and thermomechanical shock internal to the warhead. These studies inform models that are used to assess the survivability of systems to various scenarios in the stockpile-to-target sequence defined by DoD.
- Due to the high brightness of z-pinch x-ray sources, experiments on the Z-machine are used to create high-temperature, highly ionized materials and measure the associated opacity.
- Implosions on the Z-machine provide unique characteristics that enable study of key physics issues. Exploration of these issues enhances the understanding of the existing stockpile and reduces risk in future stockpile changes.

A.2.6 SNL/NM General Facilities and Activities

A.2.6.1 SNL/NM General Infrastructure/Enabling Operations/Miscellaneous Operations to Support Mission Priorities

Mission-enabling infrastructure supports all SNL/NM programmatic needs and is essential to making sites habitable, including assets for communications, power (including maintenance and testing of emergency backup generators), water, sewer, natural gas, storm drainage, emergency services, offices, site roads, pedestrian paths and parking, storage, maintenance shops, and waste management. Other services essential to the support of SNL/NM's mission-driven activities include environmental protection, emergency management, safety programs, industrial hygiene, radiation protection, and occupational health. SNL/NM is comparable to a small city, with hundreds of buildings, hundreds of miles of roads, maintenance services for vehicles (fleet), and basic utility support services for its population. Mission support assets also include cafeterias, electrical substations, analytical laboratories, and business functions. The enabling infrastructure supports the execution of all SNL/NM portfolios.

A.2.6.2 Utilities

SNL/NM demands 24-hour, highly reliable utilities and support services. Chapter 4, Section 4.11, of this SWEIS provides details on the utility infrastructure at SNL/NM. Like many government agencies, cities, and counties, SNL/NM is operating some facilities and infrastructure longer than expected. Support utilities and infrastructure are the foundation of all mission facilities. Some of this infrastructure is beyond its useful life, increasing maintenance costs and reliability risks. Aging infrastructure and the need for reliable, code-compliant systems create gaps that require ongoing investment. Existing infrastructure capacity must also be

increased to meet the projected load demands of the future. As discussed in Chapter 3, Sections 3.3 and 3.4, of this SWEIS, NNSA is proposing several infrastructure improvement projects, including upgrades to the following systems: electrical, information technology (IT)/communications, sanitary sewer, water supply, chilled water, stormwater, and electric vehicle charging.

Mission needs may at times require plans for upgrading, rebuilding, or construction of powerlines, and contracts, policies, marketing, and allocation plans for electrical power.

Chapter 3 describes anticipated and proposed work in these areas for the timeframe covered by this SWEIS.

A.2.6.3 Roads and Parking

SNL/NM manages and maintains hundreds of miles of roads, pathways, and parking areas. Chapter 4, Section 4.10, of this SWEIS describes the transportation network on and around SNL/NM. As discussed in Chapter 3, Sections 3.3 and 3.4, of this SWEIS, NNSA is proposing many road and parking improvement projects, including parking structures to free up valuable real estate and reduce the heat island effect.

A.2.6.4 Office and Warehouse Space

SNL/NM includes about 7 million square feet of facilities, office, and warehouse space. As discussed in Chapter 3, Sections 3.3 and 3.4, of this SWEIS, many of these facilities are aging and have been used longer than expected due to limited capital for rebuilding. Consequently, as discussed in those sections, this SWEIS includes proposals to construct numerous new facilities, offices, and warehouses, many of which would be direct replacements for existing facilities.

A.2.6.5 Emergency Services and Emergency Response

This includes emergency response to fires, medical emergencies, regional earthquakes, and other significant onsite incidents that may require a collaborative response by SNL/NM and city, county, state, and federal agencies.

SNL/NM has a memorandum of understanding (MOU) and base service agreement with Kirtland Fire and Emergency Services (KEFS) for response to emergencies, not including security incidents. KEFS is located within KAFB and operates five stations. Fire Stations 1, 2, 3, and 5 are always fully staffed; Station 4 is only staffed Monday through Friday for six to eight hours daily, depending on KAFB flight operations. KFES has established Mutual Aid and Support Agreements for additional emergency response capabilities with the City of Albuquerque Fire Department, Valencia County Fire Department, Bernalillo County Fire Department, Cibola National Forest (CNF), New Mexico Department of Health, Albuquerque Air Traffic Control/Sunport, New Mexico Department of Public Safety, Bernalillo County Sheriff Department, and the City of Albuquerque Police Department.

The Emergency Management Program prepares for emergencies by developing comprehensive emergency plans and procedures and conducting training and drills. The program implements performance-based exercises to demonstrate response capabilities and conducts programmatic assessments as part of readiness assurance. The program is based on the national Incident Management System. Emergency management staff coordinate and collaborate with KAFB, local, state, federal, and tribal governments, as well as non-profit and private sectors for emergency preparedness and response through mutual aid agreements and other preparedness initiatives and activities. The Emergency Management Program has developed response plans for fire, hazardous material release, medical emergencies or serious infectious disease, natural phenomena emergencies, confined space activities, and security incidents.

A.2.6.6 Security

SNL/NM is home to a broad spectrum of national security assets and is responsible for their protection, which requires enhanced security measures. To execute its safeguards and security mission, SNL/NM operates and maintains a number of site infrastructure facilities and systems. These include protective force training and operations facilities, physical protection elements (fences, gates, access-control and intrusion detection systems, video surveillance systems, and barriers), and systems supporting security clearance and badging functions. This protects against a broad range of threats. Security threats include unauthorized access, cyber threats and electronic intrusion, theft or diversion of nuclear material, sabotage, espionage, loss or theft of classified matter and proprietary information, destruction of government-owned and SNL/NM-managed property, and other hostile acts.

A primary aspect of the SNL/NM protection strategy is a sophisticated IT access-control and intrusion detection system. This system meets such stringent security requirements that the DOE Office of Defense Nuclear Security has cited it as the standard for physical security systems protecting facilities. As it monitors and controls entry into buildings requiring enhanced security, this system is continually monitoring SNL/NM for security threats and can alert and direct security forces to those threats. SNL/NM's sensitive information, materials, and facilities are thoroughly protected; intruders can be detected in real-time; and intrusions and emergencies receive prompt response from law enforcement and investigative personnel. SNL/NM is provided with continuous forms of security 24 hours a day, 7 days a week.

A.2.6.7 Environment, Safety, and Health

SNL/NM implements an Integrated Safety Management System to ensure safe operations. SNL/NM personnel integrate safety into management and work practices at all levels, so missions are accomplished while protecting members of the workforce, the public, and the environment. SNL/NM integrates consideration for the environment, safety, and health (ES&H) throughout the lifecycle of its operations, ensuring:

- protection of members of the workforce by providing a safe and healthful workplace during normal operations, abnormal conditions, and emergency incidents;

- protection of the environment by preventing or minimizing pollution and waste, pursuing sustainable resource use, and protecting biodiversity and ecosystems;
- protection of the public through the prevention or minimization of and response to releases of hazardous materials;
- compliance with applicable ES&H requirements, including contractual requirements; and
- establishment, measurement, and monitoring of ES&H objectives to enhance performance and drive continual improvement.

Environment. The Environmental Management group comprises an overarching Environmental Management System (EMS) structured to identify environmental aspects of the site, set environmental objectives, and monitor the overall environmental performance of SNL/NM. The SNL/NM EMS provides an integrated approach for management and members of the workforce to identify and to manage environmental risks and is conducted in accordance with the International Organization for Standardization 14001:2015 standard for EMSs (ISO 2015).

The SNL/NM EMS is the primary platform for implementing the environmental management groups that ensure environmental compliance obligations. Groups conduct fieldwork to collect samples (including air, water, and soil samples), identify sites or ecological activities, respond to spills or weather events, and conduct all activities required for environmental regulatory compliance across the KAFB site as needed. These environmental groups include:

- **Air Quality Compliance (AQC):** Supports compliance with air quality regulations, permits, and other requirements. The AQC program obtains and maintains permits and registrations, assists and guides line organizations in complying with permit conditions and regulatory requirements, assesses the impact of new laws affecting regulations on SNL/NM activities, and develops plans to achieve and maintain compliance. SNL/NM's AQC program includes several subject areas: stationary sources, fugitive dust, open burn permits, greenhouse gas (GHG) inventory, and oversight for management of ozone-depleting substances and refrigerants.
- **Ambient Air Surveillance:** Monitors ambient air quality for particulate matter (PM) and analyzes for metals and radiological constituents.
- **Cultural Resource Management:** Reviews and documents potential impacts on archaeological sites and historic properties. This program ensures compliance with Section 106 of the National Historic Preservation Act (NHPA) (54 of the United States Code [U.S.C.] § 300101 et seq.), updates cultural resources data relevant to SNL/NM, conducts archaeological field studies, conducts cultural resource surveys, and prepares documentation associated with the findings and retains and submits all relevant documents. The cultural resources management program writes plans for cultural resource management at SNL/NM, addressing subjects such as large-scale activities undertaken to protect cultural resources.
- **Ecology:** Monitors biota as an element of the overall environmental monitoring process for compliance with wildlife regulations and laws and to support land use decisions.

Ecological and wildlife awareness campaigns are conducted to ensure safe work environments and sustainable decision-making strategies. The Ecological Program works in conjunction with Facilities and Emergency Management to maintain regulatory compliance by requiring a biologist to review all work orders potentially impacting federally listed species, particularly those associated with the Endangered Species Act (ESA) (16 U.S.C. §§ 1531–1534) and the Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. §§ 703–712), and potentially the Marine Mammal Protection Act, if applicable with locations in the United States. The Ecology Program writes plans for vegetation management, wildlife habitat plans, and other natural resource areas at SNL/NM. These plans address subjects such as large-scale activities undertaken to protect, restore, or improve wildlife habitat.

- Environmental Education Outreach: Interacts with the community through various events and information campaigns, including at offsite locations such as schools and universities.
- Environmental Release Response and Reporting: Provides support to the Emergency Operations Center, Facilities and Emergency Management, and various line customers in the event of any environmental releases. The program responds to and performs cleanup, potential environmental media sampling, and waste characterization of small spills and releases to the environment.
- Environmental Restoration and Long-Term Stewardship: Manages legacy sites and associated post-closure care activities, minimizing environmental liability by ensuring environmental compliance with New Mexico Environment Department (NMED) permits.
- Hazardous Waste Permitting and Compliance: Supports SNL/NM hazardous and mixed waste management activities, maintains required permits for waste storage and treatment, and provides guidance to SNL/NM personnel for maintaining compliance with permits and applicable regulations.
- Materials Sustainability and Pollution Prevention: Promotes, investigates, facilitates, and implements resource conservation, waste minimization, recycling, and green purchasing to achieve materials sustainability for operations and supply chain management at SNL/NM. SNL/NM personnel are required to procure products and services that are environmentally preferable and in a manner that promotes the expanded use of green products, reduces GHG emissions, and protects the health and well-being of building occupants and visitors.
- Meteorology: Monitors the weather through a network of meteorological observation towers located across KAFB. This program includes using tools and analysis techniques that characterize atmospheric transport and dispersion conditions near SNL/NM, provide crucial atmospheric data and analyses to meet personnel and programmatic safety objectives, provide weather forecasting support services ahead of planned outdoor operations, support emergency operations, support environmental monitoring and surveillance activities, and support field testing operations.
- NEPA (42 U.S.C. § 4321 et seq.): Coordinates with DOE to ensure NEPA compliance and to provide technical assistance in project planning.

- **Oil Storage:** Manages, operates, and maintains oil storage containers and equipment to prevent inadvertent releases to the environment and to comply with applicable regulations. SNL/NM maintains a site-specific Spill Prevention Control and Countermeasures plan that defines guidelines, practices, and procedures for the storage and handling of oil to prevent unintentional discharges and ensure safe, efficient, and timely response in the event of an oil release. The NMED Petroleum Storage Tank Bureau requires annual registration of regulated above-ground and underground storage tanks, as well as development and implementation of operation and maintenance plans for each underground and above-ground storage tank site.
- **Quality Assurance:** Conducts all environmental monitoring in accordance with program-specific plans that contain applicable quality assurance elements and meet appropriate federal, state, and local requirements for sampling and analytical activities.
- **Radioactive Element NESHAPs:** Tracks and reports on radionuclide radioactive element air emissions from SNL/NM facilities. The primary activities associated with this program include requesting radiological air emissions data from line organizations; obtaining meteorological, agricultural, and population data; performing air dispersion modeling and radiation dose assessments; and conducting regulatory reporting.
- **Safe Drinking Water Protection:** Coordinates with KAFB to ensure that the water provided to SNL/NM complies with NMED regulations. Program operations consist of water quality sampling associated with water line disinfection associated with new construction and line repair and water quality investigations.
- **Stormwater:** Maintains three National Pollutant Discharge Elimination System (NPDES) permits: General Permit for Discharges from Construction Activities – Construction General Permit (CGP), Multi-Sector General Permit (MSGP) for Stormwater Discharges Associated with Industrial Activity, and Middle Rio Grande Watershed Based Municipal Separate Storm Sewer System permit. The purpose of the Stormwater Program is to protect surface water quality and the environment by minimizing the discharge of stormwater pollutants from SNL/NM and to comply with federal, state, and local stormwater regulations. The SNL/NM Stormwater Program supports construction activities at SNL/NM by developing stormwater pollution prevention plans, obtaining stormwater permit coverage, and communicating the requirement to maintain pre-development hydrology onsite. The program maintains (1) a stormwater pollution prevention plan for permits covering stormwater from site-wide industrial activities, and (2) a stormwater management program plan for site-wide stormwater permit coverage of the Municipal Separate Stormwater Sewer System. For projects occurring in or near waters of the United States, the program is responsible for securing applicable permit coverage and complying with floodplain management requirements.
- **Surface Discharge:** Minimizes the volume and concentration of toxic pollutants in surface discharges and ensures compliance with policies, regulations, and directives. The Surface Discharge Program obtains and maintains surface discharge permits and assists activity level work in complying with all permit conditions and regulatory requirements. Proposed discharges are evaluated for potential contaminants to determine whether the discharge complies with strict water quality guidelines for surface releases.

- **Terrestrial Surveillance:** Maintains a surveillance program that collects and analyzes environmental media (soil, sediment, and vegetation) samples to determine possible migration of contaminated material to offsite locations. In addition to the environmental media samples, ambient external gamma radiation levels are measured using optically stimulated luminescence dosimeters. These surveillance activities are conducted at designated locations on and near DOE fee-owned or leased property.
- **Wastewater Discharge:** Minimizes the volume and concentration of toxic pollutants in wastewater discharges through environmentally acceptable and cost-effective means to ensure compliance with regulations, policies, and directives. The SNL/NM Wastewater Discharge Program monitors wastewater discharged from six permitted onsite outfalls for compliance with the Albuquerque Bernalillo County Water Utility Authority (ABCWUA).

Safety and Health. SNL/NM maintains a documented and DOE-approved Integrated Safety Management System, ensuring that individuals are protected from hazards and their mission is accomplished safely. Safety programs include, but are not limited to, electrical, explosives, construction, pressure, radiation protection, industrial hygiene, primary hazard screening, occurrence/event reporting, and exposure assessment. Several safety programs are highlighted in this section.

Radiation Protection. The radiation protection program monitors radiation exposure and prescribes controls for the various radiological activities performed at SNL/NM. Program components include:

- The Radiation Protection Dosimetry Program provides radiation dose monitoring to assess the potential for radiation exposure, personal external dosimetry, and radiobioassay analysis and dose assessment services.
- The Radiation Protection Sample Diagnostics (RPSD) Program provides radioactive and stable chemical analytical services to SNL/NM and government agencies.
- The Device and Radioactive Source Tracking System registers and tracks radiation-generating devices and radioactive sources.

Explosives Safety. Explosives Safety provides scientific engineering analysis, experience and expertise, and explosives operations methodologies and best practices to all members of the workforce. This program is responsible for maintaining and monitoring the Explosives Inventory System, developing Explosives Safety Site Plans (ESSPs) and Explosives Building Licenses, providing training, and performing all other activities related to ensuring safe operations involving explosives.

Industrial Hygiene Assessments. Industrial hygiene professionals anticipate, identify, and evaluate chemical, biological, and physical agents in the workplace. Resulting assessments specify hazard control measures to abate or prevent exposures to ensure worker health and safety.

Event Reporting and Management. SNL/NM maintains an event reporting and management system. Event reporting, including injury and illness, environmental releases, and accidents are tracked and reported through an online system. The system includes documentation of the associated investigations, causal analysis results, and corrective action management for the events.

Safety Training & Consultation. ES&H provides specialized training, assessments, and technical support to the SNL/NM workforce to facilitate the integration of safe work practices.

Occupational Medicine. Occupational medical services are provided to workers at SNL/NM. The Occupational Medicine facility houses medical personnel to support SNL/NM's workforce. SNL/NM employees can schedule appointments in Employee Health Services for surveillance exams, or they can be seen for urgent care, personal health care, or work-related injuries and illnesses. The Worker Health Protection Program also provides free medical screening for former and current workers at 14 DOE sites across the country, including SNL/NM, to provide medical screening to detect work-related illnesses at an early stage when medical intervention may be helpful. In addition, the program helps workers determine whether a current health condition is the result of a work-related exposure.

A.2.6.8 Leased Facilities

SNL/NM has leased facilities in the Albuquerque area and in select locations in the United States supporting both corporate and programmatic needs.

Lease holdings supporting corporate needs in the Albuquerque area include:

- Computer Science Research Institute – Work at this location is related to information and computing sciences research. Lease renewal is anticipated.
- Cyber Engineering Research Laboratory – Work at this location involves computer science and technology operation. Short-term lease renewal is anticipated, to support the exit strategy.
- Center for Global Security and Cooperation – Work at this location supports national security and nonproliferation initiatives. The preferred strategy is NNSA acquisition.
- Center for Commercialization + Collaboration – Work at this location includes office work and business meeting space in support of SNL/NM technology transfer programs. Lease renewal is possible.
- Innovation Parkway Office Center – Work at this location supports a number of SNL/NM mission support services, including an IT hub and the badging office. Lease re-competition is expected in fiscal year (FY) 2027 or FY 2028.

Lease holdings supporting programmatic needs in the Albuquerque area include:

- Buena Vista – Provides office space and high bay space. Lease renewal or purchase of the facility is anticipated.

- Advanced Materials Laboratory (AML) – Laboratory space leased from the University of New Mexico, allowing for a collaborative venture between SNL/NM and the University. Laboratory work includes research in materials synthesis, processing, and characterization. This leased space is expected to be augmented by a High Bay Bridging Lease, then replaced by new space at the Center for Advanced Manufacturing & Innovation (CAMINO), an NNSA acquisition. This investment will include the current activities performed at AML; future operations include the handling and use of metal powders.
- CAMINO High Bay Bridging Facility – Leased facility for warehouse, laboratory, and office space to be used as the AML bridge toward the permanent CAMINO facility. The space allows increased advanced manufacturing capabilities in an offsite location maximizing access to industry and academic partners.
- La Semilla Sled Track Buffer Zone – Leased land creating a buffer between the western boundary of KAFB and nearby developments. This is a 100-year lease from the New Mexico State Land Office.

Lease holdings supporting programmatic needs outside of the Albuquerque area include:

- Belen Radar Reflector – Leased radar array near the Alexander Municipal Airport in Belen, south of Albuquerque, supports R&D of high-performance synthetic aperture radar systems. Lease renewal is possible.

A.3 PROPOSED ACTION AND ALTERNATIVES – SUPPLEMENTAL INFORMATION

This section provides supplemental information for the Proposed Action and Alternatives described in Chapter 3 of this SNL/NM SWEIS.

A.3.1 Introduction and Development of the SNL/NM SWEIS Alternatives Supplemental Information

A primary challenge in preparing a site-wide analysis is to address the impacts of the individual projects/actions while also addressing the totality of impacts. To accomplish those dual goals, NNSA defined and accumulated data relative to defined projects/actions proposed within alternatives. For each project/action, NNSA consulted with subject matter experts from SNL/NM to quantify key parameters. The accumulated parameters are shown in Table A-2 (for construction) and Table A-3 (for operations). For example, for each alternative, construction activities have the potential to result in land disturbance. Table A-2 shows the results of accumulating those construction land disturbances for all projects/actions for each alternative.

This same process was used to develop operational parameters such as workforce, water use, and waste generation, for example. In some instances, the changes in accumulated parameters presented in Table A-2 and Table A-3 are largely driven by the contribution of one or two new projects/actions. For instance, as shown in Table A-3, increased water and electricity usage at SNL/NM in the future would primarily be associated with cooling water usage for the operation

of the ECIL and EDAF, which are proposed actions under the Expanded Operations Alternative. These facilities would contain high-performance computers and data centers, which are intensive electricity users and require significant cooling water. As this example illustrates, in developing the key parameters for the SWEIS analysis, NNSA can account for projects/actions both individually and in totality, and the analysis in this SWEIS addresses each of these aspects.

Because operations are based on steady-state conditions, most parameters in Table A-3 were estimated to reflect operations at a given level. One exception to this is waste generation, which includes construction/decontamination, decommissioning, and demolition (DD&D) wastes in Table A-2 as “non-routine” wastes that would result from DD&D actions. Once the key construction and operational parameters were developed, resource experts used those parameters to conduct the impact analysis presented in Chapter 5.

Table A-2. Key Construction Parameters for the SNL/NM SWEIS Alternatives

Resources	Baseline Data ^a	No-Action Alternative (2025–2030) ^b	Modernized Operations Alternative (2025–2040) ^{c, d}	Expanded Operations Alternative (2025–2040) ^{c, e}
Development footprint	SNL/NM is approximately 16,532 acres in size, with 6.9 million ft ² of developed space (158 acres total) in 910 facilities	13.1 acres total (7.1 acres for facilities, 5 acres of new permanent staging area, 1 acre substation)	42.0 acres total; (38 acres for facilities, 3 acres for utility corridor, 1 acre for substation)	1,542.1 acres total (73.8 acres for facilities, 3 acres for utility corridor, 1 acre for substation, 1,441 acres for expanded energy projects, 20 acres for roads, 3.3 acres for fence)
Land restored ^f by DD&D	Approximately 200 structures, totaling 434,000 ft ² (10 acres total) have undergone DD&D	2.7 acres total	12.4 acres total	25.3 acres total
Net land use effect	N/A	10.4 acres developed	29.6 acres developed	1,516.8 acres developed (48.5 acres for facilities, 1,468.3 acres for expanded energy projects and infrastructure)
Other contractor workforce (for construction, DD&D, and other non-operational work)	Total SNL/NM employment: 13,078 workers (2022) plus 1,300 other contractors	1,300 other contractors (no change from baseline)	1,500 other contractors (+200 above No-Action Alternative)	1,800 other contractors (+500 above No-Action Alternative)
Fuel	310,000 gal/yr of petroleum and diesel (average [avg.] 2017–2021)	Operational values account for construction fuel.	Operational values account for construction fuel.	Operational values account for construction fuel.
New concrete	N/A	7,900 cubic yards/yr (2025–2030)	10,100 cubic yards/yr (2025–2040); increase of 2,200 cubic yards/yr above No-Action Alternative	17,700 cubic yards/yr (2025–2040); increase of 9,800 cubic yards/yr above No-Action Alternative
Water use	322 million gal/yr (avg. 2017–2022)	Increase of 0.6 million gal/yr above baseline	Increase of 1.1 million gal/yr above No-Action Alternative	Increase of 1.1 million gal/yr above No-Action Alternative
Wastewater	250 million gal/yr (2022)	No increase above the baseline.	Increase of 1.3 million gal/yr over No-Action Alternative	Increase of 3.2 million gal/yr over No-Action Alternative

a. Baseline data are the best estimate of current operational conditions/data. Baseline data were collected from available data in 2021 for the 5-year period between 2017–2021. For some environmental resource areas, baseline data were collected from available data in 2022 for the 6-year period (2017–2022).

- b. New facilities and DD&D would be completed by 2030.
- c. New facilities and DD&D would be completed by 2040.
- d. The values presented in this column are incremental additions to the values associated with the No-Action Alternative, which is the benchmark against which the action alternatives are compared.
- e. The values presented in this column reflect the values for the Modernized Operations Alternative and the incremental additions to those values associated with the Expanded Operation Alternative projects shown in Chapter 3, Table 3-5. These are the total values associated with the Expanded Operations Alternative (i.e., the total incremental values above the No-Action Alternative for all the projects listed in Chapter 3, Tables 3-3 and 3-5).
- f. “Restored,” in this instance, means that lands associated with DD&D would become brownfield sites that could be made available for future reuse.

Table A-3. Key Operational Parameters for the SNL/NM SWEIS Alternatives

Resources	Baseline Data ^a	No-Action Alternative (Steady State in 2030) ^b	Modernized Operations Alternative (MOD) (Steady State in 2040) ^{c, d}	Expanded Operations Alternative (EXP) (Steady State in 2040) ^{c, e}
Development footprint	SNL/NM is approximately 16,532 acres in size, with 6.9 million ft ² of developed space (158 acres total) in 910 facilities	13.1 acres total	42.0 acres total	1,542.1 acres total (73.8 acres for facilities, 1,468.3 acres for expanded energy projects and infrastructure)
Land no longer occupied as a result of DD&D	Approximately 200 structures, totaling 434,000 ft ² (10 acres total) have undergone DD&D	2.7 acres total	12.4 acres total	25.3 acres total
Net land use effect	N/A	10.4 acres developed	29.6 acres developed	1,516.8 acres developed (48.5 acres for facilities, 1,468.3 acres for expanded energy projects and infrastructure)
Operational workforce	Total SNL/NM: 13,078 (2022) workers	13,078 workers	14,960 workers	17,950 workers
Electricity	286,000 MWh/yr 52 MW peak	340,000 MWh/yr 87 MW peak	388,000 MWh/yr 93 MW peak	440,000 MWh/yr 102 MW peak
Natural gas usage	282 million ft ³ /yr (avg. 2017–2021)	325 million ft ³ /yr in 2030	393 million ft ³ /yr in 2040	470 million ft ³ /yr in 2040
Fuel (oil, gasoline, diesel) usage	310,000 gal/yr of petroleum and diesel (avg. 2017–2021)	341,000 gal/yr	375,100 gal/yr	412,610 gal/yr
Water use	322 million gal/yr (avg. 2017–2022)	342 million gal/yr	359 million gal/yr	411 million gal/yr
Wastewater	250 million gal/yr (2022 value)	250 million gal/yr	262 million gal/yr	281 million gal/yr

Resources	Baseline Data ^a	No-Action Alternative (Steady State in 2030) ^b	Modernized Operations Alternative (MOD) (Steady State in 2040) ^{c, d}	Expanded Operations Alternative (EXP) (Steady State in 2040) ^{c, e}
Radiological air emissions (curies [Ci]/yr)	47 Ci (avg. 2017–2021)	47 Ci	52 Ci	87 Ci
Workforce that receive measurable total effective dose	120 SNL/NM workers, of which 25 work at ACRR (avg. 2017–2021)	120 SNL/NM workers, of which 25 work at ACRR	200 SNL/NM workers, of which 25 work at ACRR	262 SNL/NM workers, of which 25 work at ACRR for the years in which ACRR operates, and 37 work at CREST once it is operational
Average dose to workers that receive measurable total effective dose	33 millirem (mrem)/yr– Most of SNL/NM workforce (avg. 2017–2021)	33 mrem/yr – Most of SNL/NM workforce	40 mrem/yr – Most of SNL/NM workforce 100 mrem/yr – ACRR	60 mrem/yr – Most of SNL/NM workforce 100 mrem/yr – ACRR 178 mrem/yr – CREST
Waste Projections				
Hazardous waste	73.4 MT/yr (avg. 2017–2022)	Routine: 100 MT/yr Non-routine: 506 MT/yr, with 253 MT/yr asbestos-containing material (ACM)	Routine: 100 MT/yr Non-routine: 948 MT/yr, with 474 MT/yr ACM above the No-Action Alternative	Routine: 150 MT/yr Non-routine: 948 MT/yr, with 474 MT/yr ACM from MOD + 893 MT/yr, with 448 MT/yr ACM from EXP delta = 1,841 MT/yr with 922 MT/yr ACM
Non-hazardous solid waste	3,046 MT/yr (includes both routine and non-routine) (avg. 2017–2022)	Routine: 4,250 MT/yr Non-routine: 1,200 MT/yr	Routine: 4,250 MT/yr Non-routine: 2,200 MT/yr above the No-Action Alternative	Routine: 6,375 MT/yr Non-routine: 2,200 MT/yr (MOD) + 1,415 MT/yr (EXP delta) = 3,615 MT/yr
Low-level waste (LLW)	61.8 m ³ /yr (avg. 2017–2022)	Routine: 87.6 m ³ /yr Non-routine: 6.4 m ³ /yr	Routine: 87.6 m ³ /yr Non-routine: 6.4 m ³ /yr	Routine: 130 m ³ /yr Non-routine: 120 m ³ /yr
Mixed low-level waste (MLLW)	53.2 m ³ /yr (avg. 2017–2022)	Routine: 93.7 m ³ /yr Non-routine: 0.1 m ³ /yr	Routine: 93.7 m ³ /yr Non-routine: 0.1 m ³ /yr	Routine: 140 m ³ /yr Non-routine: 0 m ³ /yr
TRU and mixed TRU wastes	1.4 m ³ /yr (avg. 2017–2022)	8.4 m ³ /yr	8.4 m ³ /yr	12.6 m ³ /yr
High-level waste	None	None	None	None
LLW/MLLW shipments	15 shipments of LLW/yr 4 shipments of MLLW/yr (avg. 2018–2021)	16 shipments of LLW/yr 16 shipments of MLLW/yr	16 shipments of LLW/yr 16 shipments of MLLW/yr	24 shipments of LLW/yr 24 shipments of MLLW/yr
TRU waste shipments to WIPP	1 annually (avg. 2018–2021)	1 annually	1 annually	Up to 5 annually

- a. Baseline data are the best estimate of current operational conditions/data. Baseline data were collected from available data in 2021 for the 5-year period between 2017–2021. For some environmental resource areas, baseline data were collected from available data in 2022 for the 6-year period (2017–2022).
- b. New facilities and DD&D will be completed by 2030. Parameters reflect steady-state operations beginning in 2030.
- c. New facilities and DD&D would be completed by 2040. Parameters reflect steady-state operations beginning in 2040.
- d. The values presented in this column are incremental additions to the values associated with the No-Action Alternative, which is the benchmark against which the action alternatives are compared.
- e. The values presented in this column reflect the values for the Modernized Operations Alternative and the incremental additions to those values associated with the Expanded Operations Alternative projects shown in Chapter 3, Table 3-5. These are the total values associated with the Expanded Operations Alternative (i.e., the total incremental values above the No-Action Alternative for all the projects listed in Chapter 3, Tables 3-3 and 3-5).

Source: SNL 2023a; SNL 2023b; SNL 2023c.

A.3.2 No-Action Alternative Supplemental Information

A.3.2.1 General

Some activities at SNL/NM are not expected to change significantly, regardless of which alternative DOE selects for continued operations. In general, the activities common to all alternatives, or balance of operations activities, involve little or no toxic materials and are of low hazard as applicable regulations are followed. Balance of operations analyses are included regardless of alternative because this work is ongoing and part of the general operation of SNL/NM. These analyses are evaluated along with the more detailed analyses of the selected facilities for each alternative to provide the total impacts from SNL/NM operations.

The balance of operations activities includes business and administrative actions and routine operations; infrastructure and central services for SNL/NM; facility maintenance and refurbishment activities; traffic flow adjustments; environmental, ecological, and management plans and natural resource management activities; and R&D laboratory and outdoor activities. Personnel follow hazard control plans and wear appropriate personal protective equipment. Waste is disposed of according to facility procedures. Appendix H to this SWEIS provides additional information on these general activities and operations.

A.3.2.2 Unmanned Systems

Within the Global Security portfolio and the Weapons and Force Protection Program, the Autonomy and Unmanned Systems Sub-Program develops and deploys intelligent systems/mobile robotics to detect, characterize, and mitigate evolving threats to critical national assets, military forces, and the public. UxS broadly include UAS, tethered balloons and free balloons, unmanned ground systems (UGS), unmanned surface vessels (USV), and unmanned underwater vessels (UUV). Activities of the Autonomy and Unmanned Systems Sub-Program include:

- R&D, testing, and evaluation of systems and technologies;
- development of hardware and software solutions;
- field training to integrate and test vehicles; and
- robotics R&D.

UxS may be either fuel or battery powered (commonly using lead acid or lithium-ion batteries) with varying weights and speed limits as identified in Table A-4.

The term “UxS” is used instead of the phrase “unmanned aircraft vehicles” because it refers to a comprehensive system including not only the vehicle but also the ground control station, communication system, and any other supporting components necessary for the operation of the vehicle. The key components of a UxS are the vehicle, ground control station, communication system, and payload. The system is the integration of all these components, which allows for the successful operation of the UxS in a wide variety of applications.

Operation and Events for UxS. Work with UxS includes laboratory testing of components and systems; fielding trials to establish reliability, endurance, range, and mobility; and modularity of mobile and portable systems. This research meets national needs requiring systems analysis and practical engineered prototypes. This work also directly supports Counterterrorism and Homeland Security missions and applications, as it seeks to develop a novel capability for first responders to potentially identify improvised explosive device components in suspect devices.

The scope of operational events for all UxS activities generally includes mobilization of 1–10 support vehicles and/or trailers and transportation and use of 2–4 portable generators that will run for up to 12 hours per flight or exercise day and may include a number of UxS uses and/or a number of UxS. Depending on the testing goals and priorities, 4–12 (and up to 25) people usually provide support.

Support vehicles are parked on established roads (paved or dirt) and cleared areas such as parking lots and graded and/or disturbed areas, and they are not driven “overland” off established roads. Operations stage and take off from previously cleared areas that are free of non-participating people and obstructions.

Table A-4 presents information on types of UxS activities for the No-Action Alternative occurring on the SNL/NM site, KAFB, and offsite locations with specific permissions.

Table A-4. UxS Activities for the No-Action Alternative Occurring on SNL/NM Site, KAFB, and Offsite Locations in New Mexico with Specific Permissions

UxS	No-Action Alternative
UAS	Aircraft Groups 1, 2, and 3 up to 300 lb • sensor and detection research flights • deployed payload flights • counter-UAS flights • energetically configured UAS with up to 1.5 lb NEW within a secure flight cage (outside of FAA airspace) on a sited explosives range • swarm up to 10 aircraft (Groups 1, 2)
UGS	Up to 3,000 lb vehicles, maximum speed 25 mph • sensor and detection research • deployed payloads
USV	Up to 20 lb, maximum speed 5 mph • sensor and detection research
UUV	20 lb, maximum speed 5 mph • sensor and detection research
Tethered Balloons	Reusable gas-filled balloons, about 500–5,000 feet above ground level
Free Balloons	Up to 100 lb payloads

UAS for the No-Action Alternative. FAA defines a UAS as an unmanned aircraft and the equipment necessary for the safe and efficient operation of that aircraft (FAA 2024). An unmanned aircraft is a component of a UAS and is defined by statute (the FAA Modernization and Reform Act of 2012) as “an aircraft operated without the possibility of direct human intervention from within or on the aircraft” (Pub. Law 112-95). UAS may be a fixed-wing, rotary-wing, or hybrid model. Fixed-wing UAS have a motor and are propelled in the horizontal

direction; rotary-wing unmanned aircraft have one or more propellers that lift in a vertical direction. Hybrid models have both fixed wings and rotors. Figure A-6 presents information on types of UAS.

UAS Groups	Maximum Weight (lbs) (MGTOV)	Normal Operating Altitude (ft)	Speed (kts)	Representative UAS	
Group 1	0 – 20	<1200 AGL	100	Raven (RQ-11), WASP	
Group 2	21 – 55	<3500 AGL	< 250	ScanEagle	
Group 3	< 1320	< FL 180		Shadow (RQ-7B), Tier II / STUAS	
Group 4	>1320		Any Airspeed	Fire Scout (MQ-8B, RQ-8B), Predator (MQ-1A/B), Sky Warrior ERMP (MQ-1C)	
Group 5		Reaper (MQ-9A), Global Hawk (RQ-4), BAMS (RQ-4N)			

Source: Melnyk 2013.

Figure A-6. Types of UAS

UAS can be remotely operated by manual navigation, global positioning system (GPS) navigation (i.e., pre-programming to fly a UAS to a specified location or in a specified pattern), and autonomous navigation (i.e., onboard computer determines flight controls using onboard sensors). UAS can access difficult-to-reach areas; are able to survey large areas; and can quickly gather, synthesize, and transmit data. The SNL/NM UAS program operates within KAFB and at specific offsite locations in New Mexico consistent with combined approvals from FAA, Federal Communications Commission, and NNSA/Sandia Field Office (SFO) via approval of an Aviation Safety Plan, and consistent with communications and engagement with the KAFB Range Management Office. UAS are flown exceeding 55 lb total upweight and exceeding speeds of 100 mph at variable altitudes within the regulatory approvals as applicable within the national air space or restricted/prohibited airspace (including single UAS and swarms of UAS).

These flights occur over SNL/NM-managed lands (e.g., the TAs, La Semilla, withdrawn lands, approved permitted lands), as well as over specific approved acreage within the KAFB boundary. In addition, flights may occur over approved Albuquerque locations: within the Sandia Research Park and facilities in the Eubank corridor (Innovation Park Office Center, Computer Science Research Institute, Cyber Engineering Research Laboratory, Center for Global Security and Cooperation), at the Maloof Air Park in Albuquerque, at Balloon Fiesta Park, and at other

approved locations within New Mexico (Socorro Municipal Airport, White Sands Missile Range, the WIPP, and limited controlled access locations for demonstrations).

The proposed activities will be conducted throughout the year as needed. Each day's test activities will be reviewed for potential environmental hazards and coordinated and scheduled with consideration for fire restrictions and KAFB operations, including those having ongoing activities in these or adjacent locations, and with KAFB Combined Firing Area Committee Range Schedule activities to prevent conflicts. Proposed UAS and counter-UAS activities are for research, development, and testing and would not include active response to live threats.

Counter-UAS activities include research, development, and testing that include non-kinetic (disruption/soft kill), kinetic (physical destruction/hard kill), and directed energy (hard kill) mitigations. Non-kinetic mitigation technologies disrupt, deceive, and/or disable UAS electronics, software and/or communications and can include RF jamming, artificial intelligence, machine learning, GNSS jamming, spoofing (GNSS or man-in-the-middle which involves interception of communications between UAS and/or ground stations), hijacking, software attacks, etc. Kinetic mitigation uses physical forces such as nets, ammunitions, sprays, and interception with other UAS including intentional physical impact/collision, etc. Directed energy includes the use of lasers, HPM, and other technologies. The integration of devices and mitigation strategies such as directed energy may be from equipment on the ground or attached to and/or associated with UAS. Some UAS activities may include controlled and uncontrolled landings due to mitigation engagement to influence the UAS causing a hard landing (planned uncontrolled landings would occur in disturbed areas).

SNL/NM UAS do not fly over areas where existing restrictions prohibit such flights (unless specific permission is obtained), such as National Parks and Monuments, designated wildlife/wilderness areas, study areas, preserves, sanctuaries, and refuges managed by (but not restricted to) the National Park Service (NPS), Bureau of Land Management (BLM), U.S. Department of Agriculture Forest Service (Forest Service), and U.S. Fish and Wildlife Service (USFWS), and State Game and Fish Land. In addition, operations do not occur in FAA restricted and prohibited airspace, areas with National Security UAS Flight Restrictions, or tribal lands (unless appropriate permissions have been obtained previously).

Types of UAS flight activities in the No-Action Alternative include the following:

- Sensor research flights: UAS with fixed payloads with cameras and active and passive sensors, maintained in line of sight. Groups 1 and 2 and Group 3 up to 300 lb. UAS may be battery or fuel operated.
 - 150 flight days⁵/year.

⁵ A flight day will be a day of flight activities in one location and could entail a number of flights and/or a number of UAS.

- Deployed payload flights: Deployed water up to 1.3 gallons expelled as a spray, inert solids up to 75 lb, in defined locations. Groups 1 and 2 and Group 3 up to 300 lb. UAS may be battery or fuel operated.
 - 50 flight days/year.
- Counter-UAS flights: Groups 1 and 2 and Group 3 up to 300 lb. UAS may be battery or fuel operated.
 - Counter-UAS flights with controlled landings.
 - 100 flight days/year.
 - Counter-UAS flights with uncontrolled landings.
 - 50 flight days/year.
- Energetically configured UAS: Groups 1 and 2 up to 55 lb. UAS may be battery or fuel operated.
 - Within a secure flight cage outside of FAA airspace (made with materials like concrete blocks and secure netting).
 - 50 flight days/year.
- UAS swarm of up to 10 aircraft operated by one pilot: Groups 1 and 2. UAS may be battery or fuel operated.
 - 25 flight days/year.⁶
- Operating UAS for demonstration purposes: Groups 1, 2, and 3 up to 300 lb. UAS may be battery or fuel operated at limited controlled access areas.
 - 25 demonstrations/year.

Dropping Operations for UAS in the No-Action Alternative. The UAS program has been authorized to drop up to about 1.3 gallons of water (expelled in a spray) and objects up to 75 lb from a height of up to 700 feet above ground, with an overall density not exceeding tungsten (19.45 grams per cubic centimeter) in areas on SNL/NM-managed locations where:

- flights are allowed by previous authorizations;
- cleared dirt is present;
- the location has been consulted on and approved by SNL/NM's archaeologist prior to activities;
- dropped objects may penetrate up to 12 inches below ground surface in hard pack dirt:

⁶ The swarm count of total exercises/year and the sensor total exercises/year will both be counted for swarms. That is, the swarm total exercises per year are not additive to the sensor counts.

- if objects are expected to penetrate 12 inches or more with a maximum of 2 feet deep, a dig permit is secured prior to dropping;
- should objects penetrate the ground, holes will be refilled with local dirt; and
- the area has been recently inspected and it has been confirmed that no personnel or wildlife are present.

Drops will not occur over:

- environmental restoration (ER) sites (e.g., an old landfill with a cover on it),
- pavement (e.g., paved roads or parking lots), or
- sandy soil where depth of impact may go more than 2 ft-bgs (0.6 meter below ground surface).

If the dropped object is specifically designed to penetrate the ground, enhanced depth calculations (e.g., finite element analysis, Monte Carlo simulation) will be performed to validate that the payload will not penetrate more than the 2-foot limitation.

Free Balloons in the No-Action Alternative. SNL/NM work with free balloons includes the inflation, launch, tracking, and recovery of free-flying balloons. Two types of balloons may be used: balloons employing lighter-than-air gas (helium) and solar -powered hot air balloons. Balloons continuously ascend to altitudes of about 82,000–131,000 feet above sea level, after which their envelopes burst and the payload returns to the surface of the Earth.

Free balloons may launch from New Mexico airports and specifically approved locations within the state of New Mexico with appropriate permissions. Free balloon demonstrations may occur at limited access-controlled locations like schools.

Solar hot air balloons use a dark colored envelope to passively heat the enclosed air, allowing them to fly as long as the sun is shining. Charcoal powder is used to darken the interior of the solar balloons. After the sun goes down, solar hot air balloons return to Earth. Solar hot air balloons are typically 20–30 feet across and reach altitudes of 50,000–100,000 feet depending on payload. If larger payloads and/or greater altitudes are desired, a solar balloon up to 43 feet across may be constructed. Weather balloons may be used to tow solar balloons aloft depending on project needs.

Payloads consist of sensor packages and a satellite tracker for recovery when necessary. Any balloon launched as part of this program must have a tracker that transmits its position every hour or less at elevations at or below 20,000 feet. Payloads could weigh up to 100 lb in two packages.

The balloon flight train contains a parachute to control descent speed. The parachute is of sufficient size to slow the payload down to 5 meters/second or less (11 mph). After landing, the payload is recovered, with personnel retrieving it on foot if necessary. Support vehicles remain on established paved or dirt roads and are not driven “overland” to retrieve payloads. In rare

instances, a payload may not be recovered if it lands in a region that is inaccessible or access is judged to be more disruptive to the environment than the loss of the balloon and payload.

The following are the free balloon activities in the No-Action Alternative:

- Research flights: Flying free balloons with fixed payloads with cameras and active and passive sensors.
 - Solar powered prototype hot air balloon: Neither the envelope nor the payload is recovered (about 1–5 flight days⁷/year).
 - Solar powered hot air balloon: Both the payload and the envelope are recovered (most commonly 10–50 flight days/year).
 - Solar powered hot air balloon: Payload is recovered, balloon is not recovered (about 5 flight days/year).
 - Weather balloons: Balloon bursts and is not recovered, with a payload released and retrieved most of the time (about 10 flight days/year).

Tethered Balloons in the No-Action Alternative. SNL/NM's Tethered Balloon System program supports field campaigns to obtain atmospheric measurements, which promote the advancement of climate models. Field campaigns using the Tethered Balloon System consist of tethered balloon flights.

Tethered balloon activities may occur at access-controlled locations with appropriate permission, such as SNL/NM-managed lands (e.g., the TAs, La Semilla, withdrawn lands, approved permitted lands), as well as over specific approved acreage within the KAFB boundary and specifically approved locations with appropriate permissions. Tethered balloon activities may occur at limited access-controlled locations like schools.

The reusable gas-filled air balloon will be deployed from an electric winch to an elevation not to exceed that of the relevant FAA waiver or applicable regulations, about 500–7,500 feet above ground level. At the end of each balloon flight, the balloon will be retrieved and stored under a net or inside an inflated hangar/shelter during the duration of the flight series and/or campaign. The balloon will be deflated and stored in a weather-tight shipping case on a trailer upon deflation and end of the flight series and/or campaign.

A commercially provided pressure regulator, helium storage cylinders, and manifold system are used to inflate the balloon. Helium cylinders will be stored in racks at the flight location. A variety of tethered balloons may be used, ranging from a 3.5-m³ finned weather balloon to a 128-m³ aerostat.

⁷ A flight day will be a day of free balloon flight activities in one location and could entail a number of flights and/or a number of free balloons.

At the end of each balloon flight campaign, the balloon will be deflated (with helium being vented to the atmosphere) and stored for future use. When not in use, the balloon system will be stored at the Atmospheric Research Instrumentation and Systems (ARIAS) Test and Integration Facility at SNL/NM.

Tethered balloons could carry an aerosol neutralizer, containing two polonium (Po)-210 strips. The half-life of Po-210 is 138.4 days. The range of the alpha particles in the air from the two radioactive Po-210 strips (0.5 millicurie each; Model 2U500; manufactured by NRD, LLC) is 3.8 centimeters, and the radiation is incapable of penetrating the stainless steel body of the neutralizer containing the strips. The alpha particles could not penetrate a layer of dead skin (about 50 micrometers thick) on the human body. The sources used in the neutralizer will not require special handling precautions beyond those described in the NRD, LLC, technical literature.

A Notice to Air Missions will be issued at least 24 hours before beginning a balloon flight. The guidelines in the approved FAA Flight Waiver will be followed regarding contacting the closest FAA air traffic control facility. The air traffic control facilities identified in the waiver will be given the names and addresses of the owners/operators, the size of the balloon, the location of the operation, and the height above the surface of the Earth at which the balloon will be operated at the specified time interval in advance of the first flight.

The following are the defined groups of tethered balloon activities in the No-Action Alternative:

- Research flights: Reusable helium gas-filled air balloons deployed from an electric winch to an elevation of about 500–7,500 feet above ground level. Balloons have fixed payloads with cameras and active and passive sensors attached.
 - 1–2 tethered initial balloon inflations/year (3,750 cubic feet [ft³] of helium for initial inflation).
 - 9–19 inflation augmentations per year (250 ft³ of helium per inflation augmentation).
 - 10–20 flight days⁸/year.
- Deployed payload flights⁹: Tethered balloons dropping objects of up to 70 lb in weight at FAA limit elevations.
 - 10–20 deployed payload flight days/year.

UGS in the No-Action Alternative. Operations of UGS on all graded or paved roadways are allowed up to a maximum of 25 mph and weight of about 3,000 lb. Engineers at SNL/NM work

⁸ A flight day will be a day of tethered balloon operation in one location and could entail a number of flights but generally just one tethered balloon.

⁹ Deployed payload flights will be counted in addition to the research flight totals/year.

with UGS in developing, fabricating, testing, and operating advanced robotic vehicles for surveillance and reconnaissance, accident response, environmental sensing, weapons delivery, security monitoring and testing, and hazardous material handling.

UGS work occurs mainly at the Robotic Vehicle Range (RVR). The RVR is located on permitted land on KAFB. The RVR is a unique 319-acre site containing both rolling hills and open desert terrain. It contains several improved dirt tracks, unimproved dirt trails, graveled areas, and an asphalt test pad. These areas provide realistic test surfaces for the evaluation and performance of mobile robotic systems. Other locations for UGS work include access-controlled locations with appropriate permission, such as SNL/NM-managed lands (e.g., the TAs, La Semilla, withdrawn lands, and approved permitted lands), other specific approved acreage within the KAFB boundary, and the WIPP. UGS demonstrations may occur at access-controlled locations like New Mexico police stations and at limited access-controlled locations like schools.

The following are defined UGS activities in the No-Action Alternative:

- Operating ground vehicles (25 mph and weight of about 3,000 lb) for research, sensors, and articulating arms interacting with the environment at the RVR and similar areas that are graded, paved, or disturbed, and access-controlled areas.
 - 260 exercise days¹⁰/year.
- Operating ground vehicles (25 mph and weight of about 3,000 lb) for movement of unfixed payloads at the RVR and similar areas that are graded, paved, or disturbed and at access-controlled areas.
 - 260 exercise days/year.
- Operating ground vehicles for demonstration purposes (25 mph and weight of about 3,000 lb) at limited controlled areas.
 - 25 demonstrations/year.

All UGS operations are subject to biological review by the SNL/NM ecology team for environmental impacts, including but not limited to impacts to threatened and endangered species per the ESA, migratory bird impacts, and marine mammal impacts.

To avoid or minimize adverse environmental impacts, SNL/NM personnel adhere to the requirements in Table A-5 and the BMPs in Table A-6 as standard procedures for UxS operations. Should BMPs not be feasible for future related SNL/NM proposed actions, project-specific NEPA documentation would be required.

USV and UUV in the No-Action Alternative. Operations of USV take place on water at the RVR (in small purpose-designated water tanks) or at outdoor locations with a usable tank or pool

¹⁰ An exercise day will be a day of UGS operation in one location and could entail a number of UGS activities and/or a number of UGS.

if available, such as within SNL/NM-managed lands (e.g., the TAs, La Semilla, withdrawn lands, approved permitted lands), as well as in specific approved acreage within the KAFB boundary and the WIPP. USV and UUV demonstrations may occur at access-controlled locations like New Mexico private training centers (should a tank or pool be available) and at limited access-controlled locations like schools.

The following are defined USV and UUV activities in the No-Action Alternative:

- Operating a small USV or UUV up to 20 lb, maximum speed of 5 mph, for research and sensors at the RVR and at similar areas at SNL/NM with access-controlled outdoor water pools.

To avoid or minimize adverse environmental impacts, SNL/NM personnel adhere to the requirements in Table A-5 and the BMPs in Table A-6 as standard practices for UxS operations. SNL/NM may implement additional BMPs for UAS flights as described in the *Final Programmatic Environmental Assessment for the Nationwide Operation of Small Unmanned Aircraft Systems* (DHS 2022). Should BMPs not be feasible for future related SNL/NM proposed actions, project-specific NEPA documentation would be required.

Table A-5. Standard Requirements for UxS Operations for Any Alternative

Resource	Requirements
Airspace	• SNL/NM UAS pilots comply with all FAA regulations. These include 14 CFR Part 107 or other governing airspace authority (e.g., an FAA Certificate of Authorization) for operations in the National Airspace, or separate authorities for restricted airspaces (e.g., DoD/DOE restricted/prohibited airspaces). Obtain approvals from FAA for airspace that is designated as Class A, B, C, D, or E. • Obtain and adhere to applicable permits, permissions, and authorizations from federal, state, and local regulatory authorities prior to using UAS.
Land and Water	• No flights over areas where existing flight restrictions exist, such as National Parks, National Monuments, and tribal lands, unless specific permission is obtained, as appropriate. • All UxS operators will acquire and maintain an appropriate operators permit and complete required safety training for the type of vehicle they are operating as if the vehicle were crewed with people. • Operate underwater and water-surface systems in suitable locations in compliance with all local, state, and federal laws. • Consult with and get approvals from the SNL/NM ecology and cultural resource programs. • Observe any local water use rules and restrictions (e.g., cleaning, draining, and drying a craft on land after use to prevent the spread of aquatic invasive species; observing speed limits; following navigational charts and channel markers to avoid sensitive areas).
Noise	• Adhere to local noise ordinances.

Resource	Requirements
Biological	- No flights over areas where existing flight restrictions for habitat exist, such as designated wildlife/wilderness areas, study areas, preserves, sanctuaries, and refuges, unless specific permission is obtained, as appropriate. - Obtain biological review from the SNL/NM ecology program for protected species at UxS locations and follow any applicable location requirements to minimize impacts. - If required, consult (informal and/or formal) with agencies including, but not limited to, USFWS and National Oceanic and Atmospheric Administration (NOAA). - Follow state and federal regulations as required by consultation prior to UxS activities. - Prior to UAS operations, conduct pre-flight readiness reviews and pre-flight checklists to identify whether birds are present or forecasted to be present during UAS operations. Maintain appropriate flight distance to reduce wildlife impacts. - Comply with the National Bald Eagle Management Guidelines.
Cultural	- If required, consult (informal and/or formal) with state, tribal, and federal entities including, but not limited to, the New Mexico State Historic Preservation Office (New Mexico SHPO), Tribal Historic Preservation Office (THPO), and Advisory Council on Historic Preservation. - Follow state and federal regulations as required by consultation prior to UxS activities. - No flights over tribal lands will occur without tribal permission. If permission is obtained, UxS operations will adhere to the agreement.

Table A-6. Standard BMPs for Any Alternative

Resource	BMPs
Airspace	- Yield the right of way to manned aircraft. - Actively avoid aerial hazards (i.e., other aircraft, birds, vessels). - Limit flight duration to as short as logistically possible. - Provide a visual observer, as needed.
Land and Water	- Conduct fueling and maintenance activities away from waters, such as at a boat yard or other appropriate location. - Avoid seagrass beds. - Use eco-friendly cleaning products that are non-toxic and biodegradable.
Noise	Maintain noise <50 A-weighted decibels (dBA) at ground level for UAS near the Pueblo of Isleta border.
Biological	- Adhere to standard published wildlife and safety protocols for all UAS flights and be as minimally invasive as possible. Do not pursue, harass, or intentionally disturb animals during breeding, nesting, rearing of young, or other critical life history functions. - Avoid flying over the same area multiple times. - When possible, launch and land from the same location, and maintain flight heights as high as possible to reduce auditory stressors and minimize disturbance to wildlife and livestock. - Operate UAS during daylight hours when possible. - Keep flight operations at an altitude as high as practical and/or allowable to limit disturbance to animals at ground level when logistically possible. When practicable, conduct UAS operations outside the nesting and breeding season in areas where breeding birds or bats could be affected. Avoid known occupied maternity roosting trees, caves, and mines to the greatest extent practicable to minimize potential impacts on bat species. - Avoid maneuvering near all animals.

Resource	BMPs
Cultural	• Avoid flying within 100 feet (30.5 meters) of known historic properties, National Historic Landmarks, monuments, or cemeteries, unless: • necessitated by an emergency facility inspection or condition assessment, or • prior notification has been given to NPS for National Historic Landmarks and to the appropriate New Mexico SHPO and/or THPO. • Do not take intentional images or video of Pueblo of Isleta during UAS flights. • Do not fly more than one UAS within 328 feet (100 meters) of the Pueblo of Isleta border.

Section A.3.4.7 contains proposed changes in UxS operations for the Expanded Operations Alternative.

A.3.2.3 Potential Explosion Sites

Potential explosion sites (PES)¹¹ at SNL/NM consist of intentional detonation sites (test ranges), explosives operating locations, and explosives storage locations. Each PES maintains an approved ESSP¹² or equivalent authorization basis that establishes the explosive limits for the PES. Each explosives range maintains an approved ESSP that governs the cited explosive weights of their intentional detonation sites, handling, and storage locations. Each approved ESSP establishes a clear zone (CZ)¹³ surrounding the PES to provide the appropriate level of protection from a detonation based on the maximum allowable explosive limit and the activities undertaken at the PES. CZs address thermal, blast overpressure, and fragmentation hazards associated with a detonation at the PES. ESSPs do not consider ground-shock, noise, or air emissions; therefore, these hazards are addressed independently in the SWEIS. The NEW limits and the number of intentional detonation sites, handling, and storage locations at any SNL/NM facility could change in the future if appropriate review and approval of a new ESSP or equivalent authorization basis is obtained. Test ranges, taken from the example major facilities listed in Table A-1,¹⁴ are geographically dispersed and may be grouped in three major regions on KAFB. Those regions and example major facilities associated with explosives test ranges are listed in Table A-7.

¹¹ A PES is the location of a quantity of ammunition and explosives that will create a blast, fragment, thermal, or debris hazard in the event of an accidental explosion of its contents.

¹² The ESSP is a formal package of explosives facility and operations safety documents to be prepared by Facility Management for DOE/NNSA approval of explosives facilities siting and operations before the operation starts. This package becomes part of the basis for explosives facility operations.

¹³ The CZ is the required minimum distance for the protection of personnel and facilities from the PES.

¹⁴ This listing is not intended to be comprehensive. Storage, operating, and indoor test facilities have been omitted. In the case of storage and operating locations, detonation activities are not planned or anticipated, and indoor test ranges rely on engineering analysis to support containment of explosives effects.

Table A-7. Example Test Ranges

Technical Area III	KAFB-West	KAFB-East
Rocket Sled Test Complex	Site 9920	Lurance Canyon Burn Site
Drop Tower/Water Impact Test Complex	Site 9930 and 9939	Aerial Cable Facility
Terminal Ballistics Facility	Site 9940	
Thermal Test Complex	Thunder Range	

Hazards from explosives test operations are based on the maximum operating capability as currently authorized by an approved ESSP. Each region was assessed to establish worst case hazard evaluation criteria based on approved ESSP for noise and seismic hazards¹⁵ detailed in Chapter 4, Section 4.7.2, and Chapter 5, Section 5.7. Test range hazard evaluation criteria are listed in Table A-8.

Table A-8. Example Test Range Capability (by region)

Region	NEW (lb)	Clear Zone (feet)	Clear Zone Exceeds Installation Boundary
TA-III	2,600	4,511	Yes but remains within La Semilla Buffer
CTF (KAFB-West)	2,000	4,133	No
KAFB-East	10,000	7,067	No

In addition to the sited intentional detonation sites, handling, and storage locations, SNL/NM also conducts static motor firing¹⁶ activities at various locations on KAFB. Each static motor firing location has an approved ESSP that establishes an explosives CZ based on applicable safety requirements. The NEW limits and the number of facilities approved for static motor firing could change in the future if appropriate review and approval of a new ESSP is obtained. Locations approved for static motor firing are geographically dispersed and may be grouped in two major regions listed in Table A-9

Table A-9. Example Static/Sled Motor Firing Facilities

TA-III	KAFB-East
Terminal Ballistics Facility	Aerial Cable Facility
Rocket Sled Test Complex	
Drop Tower Complex	

¹⁵ Anticipated air emissions are a function of test frequency and are addressed by the No-Action, Modernized Operations, and Expanded Operations Alternatives detailed in Sections 3.2, 3.3, and 3.4.

¹⁶ Static motor firing is intentional ignition or initiation (via the design mode of ignition or initiation) of a motor (liquid or solid propellant) on a static test stand where the test item is restrained from becoming propulsive, or on a rail sled where propulsive movement of the test item is constrained to a defined path.

Noise and ground-shock hazards are assessed against the largest authorized operating limit in each area, as described in Table A-10.

Table A-10. Example Static/Sled Motor Firing Capability (by region)

Region	NEW (lb)	Clear Zone (feet)	Clear Zone Exceeds Installation Boundary
TA-III	10,000	1,250	No
KAFB-East	4,000	1,250	No

The frequency of explosive tests within established weight ranges is kept for each explosives range within the bounds of the annual open burn permits with the City of Albuquerque. Approved frequency of explosive tests could change in the future, if approved in City of Albuquerque open burn permits. All explosives range tests are conducted within the requirements imposed by applicable permits, safety requirements, and deconflictions with KAFB. SNL/NM uses a comprehensive explosives safety program to manage explosives, with DOE-STD-1212-2019, Change Notice No. 1 (DOE 2021), as the controlling document.

A.3.3 Modernized Operations Alternative Supplemental Information

This section provides supplemental information for the Modernized Operations Alternative and includes high-level descriptions of changes to the portfolios (Section A.3.3.1 through A.3.3.6) as well as a project-specific description of the NGE+ (Section A.3.3.7).

A.3.3.1 Nuclear Deterrence Supplemental Information

SNL's Nuclear Deterrence portfolio manages the Nation's nuclear weapons stockpile. Nuclear Deterrence provides research, development, and testing services and manufactures specialized non-nuclear products and components for national defense and security applications. Modernization efforts would include:

- The current ACRR facility is approaching 70 years old from a facility and infrastructure perspective and is over 45 years old from a programmatic equipment perspective. Until the facility can be replaced, NNSA proposes an extended life plan for ACRR and other TA-V facilities.
- The Saturn Accelerator will undergo a refurbishment of both programmatic equipment and infrastructure that support the accelerator.
- Advances continue to be made with Electrical Sciences platforms to address RF and electromagnetic environments for experiments and modeling.
- The Z-machine would continue operations up to and including regulatory limits. This will fully utilize the power and capability of the facility. Z-machine sustainment is a critical component for mission activity until a replacement facility can be realized.
- The facilities and infrastructure for the MESA Complex are rapidly aging. This, coupled with the MESA Complex's aging equipment, poses potential reliability issues. Extended

life program investments would continue to be made to sustain the existing capability at the MESA Complex.

A.3.3.2 Global Security Supplemental Information

The Global Security portfolio aims to protect the Nation from strategic WMD threats, at home and abroad, by developing and deploying integrated technical solutions to monitor and assess emerging threats; protect materials and critical assets; and mitigate their effects through rapid identification, characterization, response, and recovery. Modernization efforts in this portfolio are expected to include:

- Modernization of Systems Mission Engineering requires upgrading to address technology maturation, advanced modeling and simulation for testing and verification of models, and ongoing maintenance and modernization of the TA-IV Antenna Field.
- Modernization in Weapons and Force Protection systems needs to integrate autonomous technologies in detection and response, be more resilient to cyber-based attacks, and allow for multiple layers of security with advanced external detection. Additionally, future systems need to minimize the reliance on human interaction with critical components, implement greater delay tactics throughout the entire system, and take a holistic approach to lifecycle security.
- Modernization in Offsite Training/Exercises would enable SNL/NM personnel to conduct, institute, and organize offsite first responder training exercises and courses in support of international, homeland, and nuclear security missions. The training courses and inspections would take place offsite at customer-requested locations, including, but not limited to, DoD, U.S. Department of Justice, and other government agency bases; local agency locations; institutions; and directed, secured locations.

When operating at offsite locations, the hosting entities would remain in full operational control with SNL/NM personnel operating as guests. Host facilities would identify and help SNL/NM personnel avoid any potential issues concerning cultural resources. Host facilities would provide guidance for the protection and avoidance of migratory birds and protected species. SNL/NM personnel would be responsible for following both host facility requirements and SNL corporate requirements as appropriate.

All explosives activities would remain on sited ranges within established range limits. SNL/NM would provide offsite training courses led by 2–12 trainers at a time and lasting 1–5 days. Training courses would include classroom briefings/instruction; hands-on classroom exercises; and field demonstrations, training exercises, and inspections, which may include constructing test articles, instrumentation hardware and software, data collection hardware, explosive tools/devices and test articles, mechanical tools, mobile generators, Class 3b/4 lasers, sealed radiological materials, and portable radiography (x-rays).

- Modernization in Asset Security and WMD Response would require growing use of machine learning in cyber systems applications.

- Modernization efforts in Monitoring Systems and Technology would push monitoring systems to incorporate and process a vast array of information based on open and multi-source domains. Additionally, detection methods would expand monitoring capabilities from single to multipurpose systems, and transition from dedicated server ground-processing to cloud-based or other novel processing methods. This would require continuing advances in:
 - advanced modeling and simulation with testing and verification of models, requiring significant computational power; and
 - increased high-rigor production capabilities and facilities for designing, developing, integrating, and testing sensitive systems hardware.
- NNSA acquisition of the leased Center for Global Security and Cooperation building, located in the Sandia Science & Technology Park, will be pursued in 2027.

A.3.3.3 National Security Programs Supplemental Information

The National Security Programs portfolio will provide trusted, threat-informed Pathfinder technologies that deny access to adversaries, create access to denied environments, provide autonomous and asymmetric advantages, and decrease adversary influence and effectiveness in targeting DoD and the intelligence community and support systems, science, technology, and expertise for national deterrence, defense, and security objectives. Modernization efforts in this portfolio are anticipated to include:

- advanced information and computing systems and upgrades to address technology maturation, and new technical and engineering solutions to process various data sources and support advanced modeling and simulation for testing and verification of models;
- integration of data science, analytics, artificial intelligence, machine learning, math, statistics, human factors, and next-generation computing architectures (e.g., quantum), which may require significant computational power and real-world, real-time data fusion;
- evolution in advanced flight systems development and testing capabilities and increasing partnerships and technology transfer activities with industry and academia to improve affordability and manufacturability of prototypes;
- innovation and development of microsystems and electronics technologies that decrease size, increase reliability, and expand capabilities;
- material growth and development of silicon and compounds, device and product design, and advanced technologies for three dimensional integration, reliability, and failure analysis;
- maturing and integration of technological advances into electronic systems and platforms utilizing the RF spectrum for command, control, communication, and information processing capabilities;

- development of cyber security and information protection options for securing next-generation high-consequence systems and mobile/wireless technologies and infrastructures across domains; and
- adoption of technology and innovations to enable efficient high-security operations in high-security facilities.

A.3.3.4 Advanced Science and Technology Supplemental Information

The AS&T portfolio leverages advanced and unique scientific and engineering capabilities to support scientific priorities for NNSA's missions. Modernization in this portfolio is expected to include:

- updates to facilities and resources funded by the Office of Science, including the CINT, Plasma Research Facility, Quantum Testbed, core materials sciences programs, core chemistry sciences programs, and core biosciences programs responding to needs in scientific advances in energy, climate, and bio-preparedness;
- technological advances in advanced scientific computational capabilities and programs to analyze, model, simulate, and predict complex phenomena (including high-performance computing, artificial intelligence, and machine learning); and
- scientific advances in quantum information sciences, including co-designing the algorithms, quantum devices, and engineering solutions needed to deliver certified quantum advantage in scientific applications.

A.3.3.5 Energy and Homeland Security Supplemental Information

The Energy and Homeland Security portfolio secures the Nation's critical infrastructures and environment against attacks and threats by performing world-class R&D. Modernization plans include:

- R&D of expanded energy production technologies;
- advances in new transportation technology and low-carbon energy carriers through experimental and computational research;
- improved grid reliability and modernization of the infrastructure: grid-forming inverters; medium-voltage power conversion; protection, control, and restoration schemes; and solid-state transformers;
- increasing the standardization, performance, reliability, and safety of energy storage systems; energy storage specific power conversion systems; and interfacing energy storage systems to the electric power grid;
- developing new advanced and adaptive protection schemes that employ machine learning for improved operation with high distributed energy resources penetration;
- applying state-of-the-art planning tools to enable microgrid design and consequence-based resilience planning for distributed energy resources placement on the grid;

- delivering distribution, planning, and workforce development products in support of the Puerto Rico Grid Modernization and Recovery;
- working with industry stakeholders to understand how to best defend the U.S. grid infrastructure;
- growth and enhancement in the areas of malware analysis, software understanding, analytics, modeling and simulation, deception, architecture design and guidance, and communications technologies operability and vulnerability, with work including research in artificial intelligence and machine learning, and physical security capabilities; and
- increased capabilities in cyber analytics, cyber architecture competencies, systems analysis, data analytics, modeling and simulation, risk assessments, real-time threat detection, contraband detection capabilities, physical security analysis, and information sciences.

A.3.3.6 Mission Enabling Supplemental Information

Mission Enabling oversees project design and construction of buildings and site infrastructure used by all SNL/NM portfolios. Modernization within the Mission Enabling portfolio includes:

- expanded energy generation to improve resiliency and independence;
- high-voltage power improvements to allow mission delivery, both in service and infrastructure (substations, etc.); and
- IT/communications expansion and upgrades, to address the fact that much of SNL/NM's IT/communications infrastructure needs modernization, prioritizing upgrades to remote sites.

The project-specific description for the NGE+ is provided in the following section.

A.3.3.7 Neutron Generator Enterprise+

NGs are miniature particle accelerators that are part of every nuclear weapon in the U.S. stockpile. NGs must meet the highest levels of reliability and survivability and be periodically replaced. In 1995, when NNSA designated SNL as the production agency for NGs, operations were moved into existing buildings, resulting in operations spread across eight buildings on multiple sites. Optimal manufacturing suggests that process steps be as geographically close to one another as possible. Material movement and product staging in multiple locations cause inefficiencies, suboptimal workflows, and increased time and risk factors (damage, loss, quality, and security). In addition, the facilities and infrastructure are aging, presenting risks to mission work, and conditions are falling below “poor” in 2025. Despite modernization or recapitalization projects, the facilities will become unfit for mission use if maintenance funding is not increased and adjusted annually thereafter to keep the buildings in adequate condition. If there is an infrastructure failure, NG production capabilities cannot be shifted easily to other facilities (SNL 2020a).

The proposed consolidated facility will improve workflow and efficiency significantly, as well as mitigate risks associated with aging facilities in deteriorating condition. This will benefit NG R&D, design, and production and enable NNSA's NG operations at SNL/NM to better meet national security needs. Specialized labs include Tritium Exhaust and Capture envelope, radiological areas, and cleanroom spaces. Flexible use space is necessary to accommodate an agile response to unanticipated requirements. Investment options must allow operations to be maintained during construction and phasing of technology transfer with limited shutdown time. If an investment is made in a new consolidated facility, all existing facilities will be repurposed for another program (SNL 2020a).

A.3.4 Expanded Operations Alternative Supplemental Information

This section provides supplemental information for the Expanded Operations Alternative and includes high-level descriptions of portfolio modernizations (Section A.3.4.1 through A.3.4.6) as well as a project-specific description in Sections A.3.4.7 through A.3.4.14.

A.3.4.1 Nuclear Deterrence Supplemental Information

Expansion proposals for the Nuclear Deterrence portfolio include:

- NNSA is currently developing a line-item scale investment planned in the form of the CREST Complex, which is intended to replace and expand ACRR capabilities in the next 10–15 years (refer to Section A.3.4.8).
- High-Performance Computing includes quantum computing capabilities (e.g., need for low-temperature capabilities at facilities).
- NNSA recognizes the need for a continued supply of microelectronics and microsystems for the nuclear deterrence and other national security missions for the foreseeable future, while also recognizing fabrication technology and equipment continue to evolve. Because of size and process limitations, NNSA is anticipating a replacement fabrication facility would be required in the next 15–25 years to replace facilities and equipment. NNSA plans a line-item scale investment in the form of the Microelectronics Components Capability (MC2) complex.

A.3.4.2 Global Security Supplemental Information

Expansion proposals for the Global Security portfolio include:

- Expansion of capabilities through intelligent systems and data-informed decisions, advanced software, and better high-performance computing infrastructure, as well as advanced modeling and simulation, would continue to support the collection of a growing amount of data.
- Advanced integrated weapon and physical security systems, as well as expansion of operations in robotics and in uncrewed automated systems, are expected. New capabilities for next-generation security systems would be developed.

Expansion plans for UAS are related to approval for use of offsite locations (with all regulatory approvals required) at federal, state, or local government sites and private or public locations around the world, as well as UAS operations within KAFB, with deconfliction with KAFB (refer to Section A.3.4.7).

- Expansion of capabilities in secure transportation solutions and intelligent systems and growth in the CTF Training Complexes are anticipated.
- Expansion of capabilities is expected in advanced modeling and simulation to support the collection of a growing amount of data. Testing and verification capabilities will be essential to demonstrate remote-sensing systems are trustworthy and performing as required.
- Development is proposed of the next generation of technology and approaches to verify, without releasing sensitive information, treaty-accountable items and critical assets.
- Growing expertise in safeguards and security for advanced small modular nuclear reactors or similar types of facilities is proposed, with investments to support associated R&D and testing (refer to Section A.3.4.10).

A.3.4.3 National Security Programs Supplemental Information

Expansion proposals for the National Security Programs portfolio include:

- Development of a strategic facility and infrastructure enabling wireless and RF spectrum R&D at all classification levels. This capability is not available within the Nuclear Security Enterprise complex, and the resulting strategic investment would enable development of new capabilities for next-generation systems and platforms.
- Expansion of rapid design and prototyping capabilities through planning and building CAMINO, a new NNSA-owned facility located offsite. This investment would include current activities performed at SNL/NM's AML.
- Identification or construction of space to accommodate a centralized location for the equipment and destruction activity across the National Laboratories.
- Expansion of forecasting capabilities to anticipate and understand emerging threats and technologies through intelligent systems and data-informed decisions, advanced software, and higher high-performance computing infrastructure, as well as advanced modeling and simulation to continue to support the collection of a growing amount of data.
- Development of a long-term facility and infrastructure solution for cyber threat capabilities and staff.

A.3.4.4 Advanced Science and Technology Supplemental Information

Expansion proposals for the AS&T portfolio include:

- scientific advances in microelectronics co-design, including cross-cutting fabrication and design of next generation microelectronics;
- developing accelerated tools to elucidate chemistry at interfaces across multiple disciplines, including aerosol chemistry plasma-assisted catalysis, photocatalysis, separations interfaces, and heterointegration (e.g., semiconductor, materials systems);
- innovative advances in discovery science of carbon negative processes, combining SNL/NM's national security perspective and differentiating capabilities in artificial intelligence/machine learning/high-performance computing, bioscience, chemical sciences, and materials science in an all-hands-on-deck call for innovation in technologies and approaches that will remove CO₂ from the atmosphere;
- the development of a multi-disciplinary predictive understanding of coupled biological and chemical processes in earth and environmental systems; and
- R&D in the accelerated discovery science for materials and chemistry systems using advanced scientific computing.

A.3.4.5 Energy and Homeland Security Supplemental Information

Expansion proposals for the Energy and Homeland Security portfolio include:

- expansion into agriculture and crop security research, which could translate into offsite work at universities or agricultural research locations;
- reactor design and implementation at the NSTTF of simulated sun and solar simulator hardware pilot-scale demonstration of solar thermochemical hydrogen production; and
- expansion into microgrid design; consequence-based resilience planning; electrical vehicle charging planning for island, remote, military, and urban scenarios; and related technical support for solar thermochemical hydrogen production.

A.3.4.6 Mission Enabling Supplemental Information

Expansion proposals for this portfolio include the items in the Modernization list and the following:

- Data center(s): SNL/NM's current data center facilities are expected to be at or beyond capacity within the next 5 years. Investments are required in both Enterprise and High-Performance Computing to meet current and future demand. An Artificial Intelligence Data Center may also be needed to support mission priorities. It is anticipated this may require up to 200 acres on KAFB property and substantial electrical and water resources. Currently, the SNL/NM location is severely limited by available power and high-voltage infrastructure, both of which would be addressed during expansion of data center facilities.

The project-specific descriptions for the Expanded Operations Alternative are provided below.

A.3.4.7 Proposed Changes in Unmanned System Operations

Under the Expanded Operations Alternative, the UxS group proposes to upgrade capabilities in operations in response to mission needs, including the use of larger UxS, flights beyond the visual line of sight (BVLOS), and swarms, as detailed in this section. Details on the proposed operations of UGS, USV, and UUV in the Expanded Operations Alternative include increases in weight and speed limits, listed in this section. Table A-11 compares the authorizations for the UxS program for the No-Action Alternative versus the Expanded Operations Alternative.

Table A-11. UxS Activities for the No-Action Alternative Compared with the Expanded Operations Alternative

UxS	No-Action Alternative	Expanded Operations Alternative
UAS	Aircraft Groups 1, 2, and 3 up to 300 lb • Sensor and detection research flights • Deployed payload flights • Counter-UAS flights Swarm up to 10 aircraft (Groups 1, 2)	Aircraft Groups 1, 2, 3 • Sensor and detection research flights (Groups 1, 2, 3) – Swarm up to 100 (Groups 1, 2) – BVLOS (up to 20 in a swarm) – Tethered (Groups 1, 2, swarm up to 20) • Deployed payload flights (Groups 1, 2, 3) – Swarm up to 100 (Groups 1, 2) – BVLOS (up to 20 in a swarm) • Counter-UAS flights (Groups 1, 2, 3 up to 300 lb) BVLOS (up to 20 in a swarm) Swarm up to 100 aircraft (Groups 1, 2) Deployed explosive/energetic payload flights (Groups 1, 2, 3) from free flight or tethered or flight cages UAS within visual line of sight
UGS	Up to 3,000 lb vehicles, maximum speed of 25 mph • Sensor and detection research • Deployed payloads	Up to 4,000 lb vehicles, maximum speed of up to 75 mph • Sensor and detection research • Deployed payloads • Deployed explosive/energetic payloads • Counter-UGS
USV	Up to 20 lb, maximum speed 5 mph • Sensor and detection research	Up to 2,000 lb, maximum speed up to 30 mph • Sensor and detection research • Counter-UUV
UUV	Up to 20 lb, maximum speed 5 mph • Sensor and detection research	Up to 1,000 lb, maximum speed up to 30 mph
Tethered Balloons	Reusable helium-gas-filled balloons, about 500-5,000 feet above ground level	Reusable helium- or hydrogen-gas-filled balloons, about 500-5,000 feet above ground level Adding the option to use hydrogen as the gas used to fill tethered balloons
Free Balloons	Up to 100 lb payloads	Up to 100 lb payloads (no change from No-Action Alternative)

UAS in the Expanded Operations Alternative. New UAS capabilities would include flights BVLOS, increased swarm sizes, and R&D using tethered UAS.

With FAA and other applicable permissions, flights would occur over all locations identified in the No-Action Alternative, as well as over all KAFB lands. In addition, flights may occur over all federal, state, county, and private lands in New Mexico with controlled access or limited controlled access with approvals and permissions.

BVLOS UAS operations refer to flying an aircraft beyond where the pilot can see the aircraft sufficiently to operate it based on sight. For a small UAS (<55 lb), this may occur at about 1,500 feet from the pilot; a pilot may be able to see a larger fixed-wing aircraft sufficiently to pilot it from about 1 mile away. FAA regulates BVLOS flights, and such flights are proposed to use the same types of ground crews and follow the requirements described in Section A.3.2.2 for the No-Action Alternative.

Swarm flights refer to one pilot operating more than one UAS at a time. The motions of two or more UAS can be called a swarm. The Expanded Operations Alternative proposes swarms of up to 100 UAS. The FAA definition of a swarm is an operation of more than one UAS in which all UAS operate in unison to commands from one pilot.

Aircraft proposed under the Expanded Operations Alternative would vary in weight, height, and operational variables.

The following are the defined groups of UAS activities in the Expanded Operations Alternative (Table A-5 and Table A-6 give descriptions, requirements, and BMPs):

- Sensor research flights: UAS with fixed payloads with cameras and active and passive sensors, maintained in line of sight (Groups 1, 2, and 3). UAS may be battery or fuel operated.
 - 260 flight days¹⁷/year.
 - UAS swarm up to 100 UAS (Groups 1 and 2, UAS may be battery or fuel operated).
 - BVLOS (up to swarm of 20).
 - Tethered:
 - up to 400 feet above ground surface,
 - Groups 1 and 2 UAS,
 - 30 days of tethered flight at a time,
 - monitored by sensors/video, and
 - up to a swarm of 20.
- Deployed payload flights: Deployed water up to 75 lb (about 9 gallons), inert solids up to 75 lb, in defined locations (Groups 1, 2, and 3). UAS may be battery or fuel operated.

¹⁷ Flight days would be a day of flight activities in more than one location and could entail a number of flights and/or a number of UAS.

- 260 flight days/year.
 - UAS swarm up to 100 UAS (Groups 1 and 2, UAS may be battery or fuel operated).
 - BVLOS (up to 20 in a swarm).
- Counter-UAS flights: Groups 1, 2, and 3 up to 300 lb. UAS may be battery or fuel operated (refer to Table A-4, Table A-5, and Table A-6 for descriptions, requirements, and BMPs).
 - Counter-UAS flights with controlled landings.
 - 260 flight days/year.
 - BVLOS (up to 20 in a swarm).
 - Counter-UAS flights with uncontrolled landings.
 - 260 exercises/year.
 - BVLOS (up to 20 in a swarm).
- UAS swarm of up to 100 aircraft operated by one pilot (Groups 1 and 2, UAS may be battery or fuel operated).
 - 260 flight days/year.
 - BVLOS (up to 20 in a swarm).
- Operating UAS for demonstration purposes at limited controlled areas.
 - 100 demonstration days/year.

Proposed UAS Dropping Operations in Expanded Operations Alternative. The UAS program operations would expand to dropping larger amounts of liquids and solid masses on controlled locations, within the requirements of host facilities and other applicable locations. Drops would either be a maximum weight as listed or a maximum liquid as listed, not both.

BMPs that would be observed in dropping operations include:

- Target area is cleared, unvegetated dirt.
- Target area has been inspected and cleared before drop to confirm that no personnel or wildlife are present.
- If objects penetrate the ground, holes would be refilled with local dirt.
- Drops would not occur over:
 - ER sites (e.g., an old landfill with a cover on it),
 - pavement (e.g., paved roads or parking lots),
 - structures, or
 - sandy soil where depth of impact may go more than 2 ft-bgs.

- If the dropped object is specifically designed to penetrate the ground, enhanced depth calculations (e.g., finite element analysis, Monte Carlo simulation) will be performed to validate that the payload will not penetrate more than the 2-foot limit.
- Over areas where dig permits are required (e.g., Air Force bases), an appropriate dig permit will be obtained prior to operation if anticipated ground penetration that triggers dig permits will be obtained.

Proposed UAS Explosives/Energetics work in the Expanded Operations Alternative. Under the Expanded Operations Alternative, the UxS program would expand operations to include UAS with and dropping of explosives for research and testing purposes on explosive test ranges, within the requirements of SNL/NM-managed lands, KAFB boundaries, host facilities, and other applicable locations in New Mexico up to 260 flight days/year.

UAS (Group 1, 2, 3) may carry and deploy explosives/energetics on explosive test ranges within range limits and within their carrying capacity, up to heights as approved by FAA and ESSPs provided all hazards (including noise and fragments) remain within the range CZ or La Semilla Buffer Zone. Explosives in test ranges are evaluated based on the largest potential explosive within each region, which is significantly higher than the carrying capacity of UAS.

Overpressure from the maximum detonation event from a UAS at the border of the CZ is expected to attenuate to less than 140 decibels (dB) prior to reaching residential areas or clearing the La Semilla Buffer Zone. Noise impacts from the three alternatives where UAS may deploy energetics/explosives are included in Table 5-19. UAS equipped with explosives/energetics may operate via tethered flight or free flight, or within purpose-built flight cages within visual line of sight. Explosive/energetic payloads would be dropped from the UAS for detonation on the ground or in the air and UAS may be impacted in some testing situations. UAS equipped with explosives/energetics in the Expanded Operations Alternative would include:

- UAS with explosive/energetic payloads (e.g., weaponizing UAS, one-way attack UAS, counter-UAS, launched UAS,) with cameras and active and passive sensors that may impact other UAS (i.e., kinetic–physical destruction).
- Dropping of explosives to detonate on the ground or in the air.
- Counter-UAS explosives/energetics activities include research, development, and testing such as ballistics (e.g., projectiles, blasts that project fragmentation), explosive deliveries, blast mitigation procedures, etc. These UAS activities would be kinetic (physical destruction/hard kill), non-kinetic (disruption/soft kill), and directed energy (hard kill) mitigations that may be combined with explosives/energetics. Kinetic mitigation uses physical forces such as nets, ammunitions (e.g., explosives/energetics, bullets), projectiles, sprays, and interception with other UAS including intentional physical impact/collision, etc. Non-kinetic mitigation technologies disrupt, deceive, and/or disable UAS electronics, software and/or communications and can include RF jamming, artificial intelligence, machine learning, GNSS jamming, spoofing (GNSS or man-in-the-middle which involves interception of communications between UAS and/or ground stations), hijacking, software attacks, etc. Directed energy includes the use of lasers, HPM, and other technologies. The integration of devices and mitigation strategies such as directed

energy, etc. may be from equipment on the ground or attached to and/or associated with UAS. Counter-UAS tests would include air to air, ground to air, and air to ground operations.

- Some UAS explosives/energetics activities may include controlled and uncontrolled landings that cause a hard landing (planned uncontrolled landings would occur in disturbed areas on explosive test range) and may destroy UAS due to mitigation engagement.
- Some UAS explosives/energetics activities may include other UxS such as UGS.

Controls on Explosives and UAS. Any planned explosives and UAS work must keep explosive hazards contained within designated explosive ranges. A mix of safety measures and rules may be used to achieve this end. Mitigation measures may change depending on the type of work proposed and the complexity of equipment involved. UAS mitigation listed below are example strategies that may be used to ensure hazards from explosives remain within sited explosive ranges:

- The person in charge of flight would control the parameters of flight and detonation to remain within the explosives range.
- UAS would be programmed to fly to a safe location should it lose signal.
- Should an anomalous condition occur, a method to disable the firing system would be implemented.
- Constrained flight methods, such as tethers or flight cages, may be employed to contain explosives and UAS.

Free Balloon Activities in the Expanded Operations Alternative. There are no proposed changes to the types of activities for free balloons in the Expanded Operations Alternative, although the number of flight days is proposed to increase:

- Research flights: Flying free balloons with fixed payloads with cameras and active and passive sensors.
 - Solar-powered prototype hot air balloon: Neither the envelope nor the payload is recovered (about 1–15 flight days/year).
 - Solar-powered hot air balloon: Both the payload and the envelope are recovered (most common: 10–75 flight days/year).
 - Solar-powered hot air balloon: Payload is recovered, balloon is not recovered (about 10 flight days/year).
 - Weather balloons: Balloon bursts and is not recovered, with a payload that is released and retrieved most of the time (about 20 flight days/year).
- Operating free balloon for demonstration purposes at limited controlled areas.
 - 10 demonstration days/year.

Tethered Balloon Activities in Expanded Operations Alternative. The tethered balloon program proposes to add hydrogen gas balloons and increase potential flight days in the Expanded Operations Alternative:

- Research flights: Reusable helium- or hydrogen-gas-filled air balloons deployed from an electric winch to an elevation of about 500–5,000 feet above ground level. Balloons have fixed payloads with cameras and active and passive sensors.
 - Helium gas flights.
 - 1–2 tethered initial balloon inflations/year (3,750 ft³ of helium for initial inflation).
 - 9–19 inflation augmentations per year (250 ft³ of helium per inflation augmentation).
 - 10–20 flight days/year.
 - Hydrogen gas flights.
 - 1–2 tethered initial balloon inflations/year (3,000 ft³ of hydrogen for initial inflation).
 - No inflation augmentations would be required for hydrogen, as the balloons would be designed to not leak.
 - 10–20 flight days/year.
- Deployed payload flights:¹⁸ Tethered balloons dropping objects of up to 70 lb in weight at FAA limit elevations.
 - 10–20 deployed payload flight days/year.
- Operating tethered balloon for demonstration purposes at limited controlled areas.
 - 10 demonstration days/year.

Another possible addition to the tethered balloon program could be a portable helium reclamation plant, which would allow for reuse of helium. This plant would require a large vehicle and a flatbed trailer to haul it to launch locations.

UGS Operations in Expanded Operations Alternative: UGS operations would continue as discussed in the No-Action Alternative. In the Expanded Operations Alternative, UGS are proposed to include up to 100 UGS demonstrations a year, up to 4,000 lb vehicles, with a maximum speed of up to 75 mph and include counter-UGS activities. Proposed UGS and counter-UGS activities are for research, development, and testing and would not include active response to live threats.

¹⁸ Deployed payload flights would be counted in addition to the research flight totals/year.

Counter-UGS activities would include research, development, and testing such as non-kinetic (disruption/soft kill), kinetic (physical destruction/hard kill), and directed energy (hard kill). Non-kinetic mitigation technologies disrupt, deceive, and/or disable UGS electronics, software and/or communications and can include RF jamming, artificial intelligence, machine learning, GNSS jamming, spoofing (GNSS or man-in-the-middle which involves interception of communications between UGS and/or ground stations), hijacking, software attacks, etc. Kinetic mitigation uses physical forces such as nets, ammunitions, sprays, interception with other UGS including intentional physical impact/collision, etc. Directed energy includes the use of lasers, HPM, and other technologies. The integration of devices and mitigation strategies such as directed energy may be from equipment on the ground or attached to and/or associated with UGS.

Counter-UGS explosives/energetics activities would occur on SNL/NM-managed lands, KAFB boundaries, host facilities, and other applicable locations in New Mexico within controlled explosive ranges (with appropriate permissions at offsite locations) include research, development, and testing such as ballistics (e.g., projectiles, blasts that project fragmentation), explosive deliveries, blast mitigation procedures, etc. These UGS activities could be kinetic, non-kinetic, and directed energy mitigations that may be combined with explosives/energetics. Some UGS explosives/energetics activities may destroy UGS due to mitigation engagement (would occur in disturbed areas on explosive test range) and may include other UxS such as UAS.

USV and UUV Operations in Expanded Operations Alternative: USV or UUV are proposed in the Expanded Operations Alternative on SNL/NM-managed lands and KAFB with appropriate permissions, or at outdoor locations in New Mexico, with weights up to 1,000 lb at speeds governed by state, federal, and local authorities with a not-to-exceed speed of 30 mph. This may include lakes and reservoirs within New Mexico with appropriate local approvals by the governing authority of the body of water, as well as review and appropriate mitigations by the SNL/NM ecology and archaeology programs. The water bodies listed in this section are the only ones currently under consideration. USV and UUV operations would have the following characteristics:

- 2,000 lb or less,
- Battery- or liquid-fuel-powered motor,
- able to fit two people on board (USV only),
- equipped with a robot articulated arm for moving things around,
- strictly testing the boat (and robotics) in the lake,
- operating only during daylight hours,
- speed up to 30 mph,
- 30 test days/year at SNL/NM or KAFB water pools,
- 20 test days/year at offsite approved New Mexico water bodies, and
- 50 demonstrations/year at limited access-controlled locations.

Counter-USV or UUV activities would occur on SNL/NM-managed lands, KAFB boundaries, host facilities, and other applicable locations in New Mexico (with appropriate permissions and controls at offsite locations) and include research, development, and testing such as non-kinetic

(disruption/soft kill), kinetic (physical destruction/hard kill), and directed energy (hard kill). Non-kinetic mitigation technologies disrupt, deceive, and/or disable USV/UUV electronics, software and/or communications and can include RF jamming, artificial intelligence, machine learning, GNSS jamming, spoofing (GNSS or man-in-the-middle which involves interception of communications between USV/UUV and/or ground stations), hijacking, software attacks, etc. Kinetic mitigation uses physical forces such as nets, ammunitions, interception with other USV/UUV including intentional physical impact/collision, etc. Directed energy includes the use of lasers, HPM, and other technologies. The integration of devices and mitigation strategies such as directed energy, etc. may be from equipment on the ground or attached to and/or associated with USV/UUV. Proposed counter-USV/UUV activities are for research, development, and testing and would not include active response to live threats.

USV and UUV Activities in the Expanded Operations Alternative: USV and UUV activities in the Expanded Operations Alternative include:

- Operating USV or UUV for research, sensors, and articulating arms interacting with the environment at KAFB, SNL/NM, or approved water bodies in New Mexico.
 - 50 exercise days/year.
- Operating USV or UUV for demonstration purposes at limited access-controlled areas.
 - 50 demonstrations/year.

A.3.4.8 Combined Radiation Environments for Survivability Testing Complex

This section provides additional details on the CREST Complex, which is one of the major projects included under the Expanded Operations Alternative discussed in Chapter 3, Section 3.4, of this SWEIS.

Need for the CREST Complex. As part of its mission, NNSA designs and qualifies electronic systems and nuclear explosives packages for combined radiation environment survivability across the lifecycle of weapons. An integrated approach to ensure survivability uses a combination of testing, analysis, and developing/deploying new technologies. A mission-critical capability supporting radiation environments testing for the stockpile is the ACRR located in TA-V. The ACRR is a water-moderated, pool-type research reactor capable of steady-state, pulsed, and tailored transient operations. The ACRR provides high-fidelity environments that can subject various test objects to mixed photon and neutron irradiation environments. Test articles, components, and systems include:

- electronic circuit boards and components (e.g., transistors, diodes);
- neutron or gamma dosimetry devices, both passive (e.g., activation, fission foils) and active (e.g., neutron/gamma detectors, semiconductor devices);
- arming, fusing, and firing systems and components;
- explosive components, including NGs, and radioactive materials (e.g., fission products, tritium);

- experiment-holding/positioning fixtures;
- neutron-spectrum-modifying fixtures (e.g., moderators, neutron absorbers); and
- nuclear and nuclear fuel materials (e.g., fissionable material for commercial, experimental, space reactor fuel types).

The facility currently housing the ACRR is inadequate to meet future mission needs. Increased facility maintenance and inefficiencies have reduced and interrupted operations. Considering planned stockpile upgrades, a new facility is needed to serve mission priorities.

The proposed CREST Complex would provide a replacement facility into which the existing, one-of-a-kind reactor fuel type (uranium dioxide–beryllium oxide [UO₂-BeO]) would be relocated, and/or possibly supplanted with new UO₂-BeO fuel. The CREST Complex would combine the current ACRR capabilities with an independent gamma-ray irradiation capability in a safe, purpose-built facility supported by new or improved nuclear material storage, handling, and processing space, as well as associated labs, offices, and infrastructure (SNL 2018a).

The CREST Complex would reduce risk to the NNSA programs by delivering the new facility in parallel with ACRR continued operations, and it would ultimately offer new capabilities. The combination of an accelerator used to provide a gamma input with the ACRR would enable time-sequenced combined environments for studying radiation impacts on test articles, components, and systems. This would enable exploration of damage mechanisms in electronics based on real-world complex environments that pose a risk but cannot be simulated with the current capability. The CREST Complex would also provide calibration and validation data and support prototyping and maturation efforts, especially by NNSA’s MESA Complex (SNL 2018a). The CREST Complex would increase the bandwidth for radiation environment testing and minimize maintenance and facility failure risks. The existing capability supports weapons designers and systems engineers in their iterative testing throughout the design development process and the qualification of non-nuclear components. Locating the CREST Complex at SNL/NM near the design and production of required radiation-hardened electrical components creates efficiencies and cost savings while minimizing risks associated with safety and security in transit of objects and personnel.

Description of the CREST Complex. Currently, SNL/NM has insufficient administrative space to support the design and development of the CREST Complex. For this reason, in 2025, NNSA intends to construct a new modular office complex north of TA-V. This would involve the construction of three modular office buildings (about 15,000–18,000 square feet), a parking lot, and sidewalks. This project would also require road improvements to Airbase Way, grading areas, stormwater retention, and utility connections. The modular office complex would be repurposed if the CREST project is not ultimately fully pursued (NNSA 2022c).

The proposed CREST Complex would be in TA-V (Figure A-7) and would be made up of three new buildings: the nuclear facility, an office/light laboratory (OLL) building, and a central utility/central alarm station facility (Figure A-8). Construction of the CREST Complex would occur during 2030–2034.



Source: SNL 2022b.

Figure A-7. Location of Proposed CREST Complex in TA-V



Source: SNL 2022b.

Figure A-8. Pre-Conceptual Depiction of Proposed CREST Complex in TA-V

The three buildings in the CREST Complex would total about 115,000 square feet.¹⁹ The nuclear facility, which would be four stories, with two of the stories underground, would encompass about 60,000 square feet. The OLL would be two to three stories high and would house all supporting light labs and the reactor/accelerator simulator. It would have space for about 145 workers. The Central Utility Building (CUB)/Central Alarm Station would be one or two stories and would house all supporting utility system labs and all supporting alarm systems (SNL 2022a).

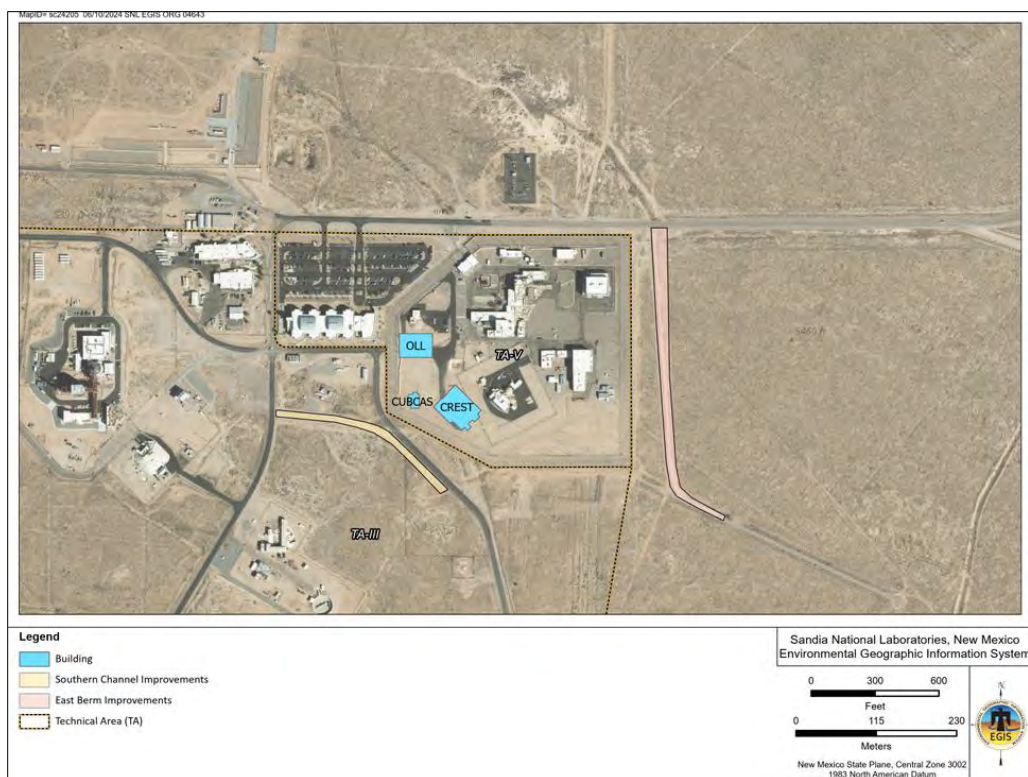
In addition to a reactor, the nuclear facility would contain an accelerator used to provide a gamma input, thus completing the desired combined testing environment to meet mission requirements of the CREST Complex. The facility would allow components to be tested in a combined and time-sequenced environment. The pre-conceptual design of the CREST facility includes hot cells for stewardship of the nuclear fuel of the reactor and for post-irradiation experiment disassembly and shipping preparation (SNL 2021b).

Flood Study. NNSA prepared a detailed flood study (SNL 2022c and SNL 2024e) to analyze the potential for flooding at the proposed CREST Complex site at TA-V. The hydraulic modeling results were used to develop drainage recommendations for TA-V versus its existing 500-year offsite eastern berm's capability/capacity. The modeling results predicted the existing 500-year offsite eastern berm would not overtop during a 500- or a 2,000-year flood event. Although the existing berm is high enough with at least 1 foot of freeboard above a hypothetical 2,000-year flood, the water circumvents the north part of the berm and floods TA-V. Therefore, the flood study report recommends that the berm is upgraded to increase this freeboard level to at least 2 feet (0.6 meter) and make drainage improvements. Excavation and replacement of the existing berm is also recommended to provide a more resilient degree of flood protection. As shown in Figure A-9, the report recommends drainage improvements within TA-V as follows:

- Construct a berm and channel at the south end of TA-V to route flow to the south and away from the proposed CREST Complex and truck ramp.
- Increase the capacity of the culvert under A3 East Road directly to the west of the proposed CUB to prevent flow from overtopping A3 East Road where it enters TA-V to the north.
- Construct a new culvert between Building 6578 and the proposed OLL building to eliminate potential flooding around the OLL building (SNL 2021b).

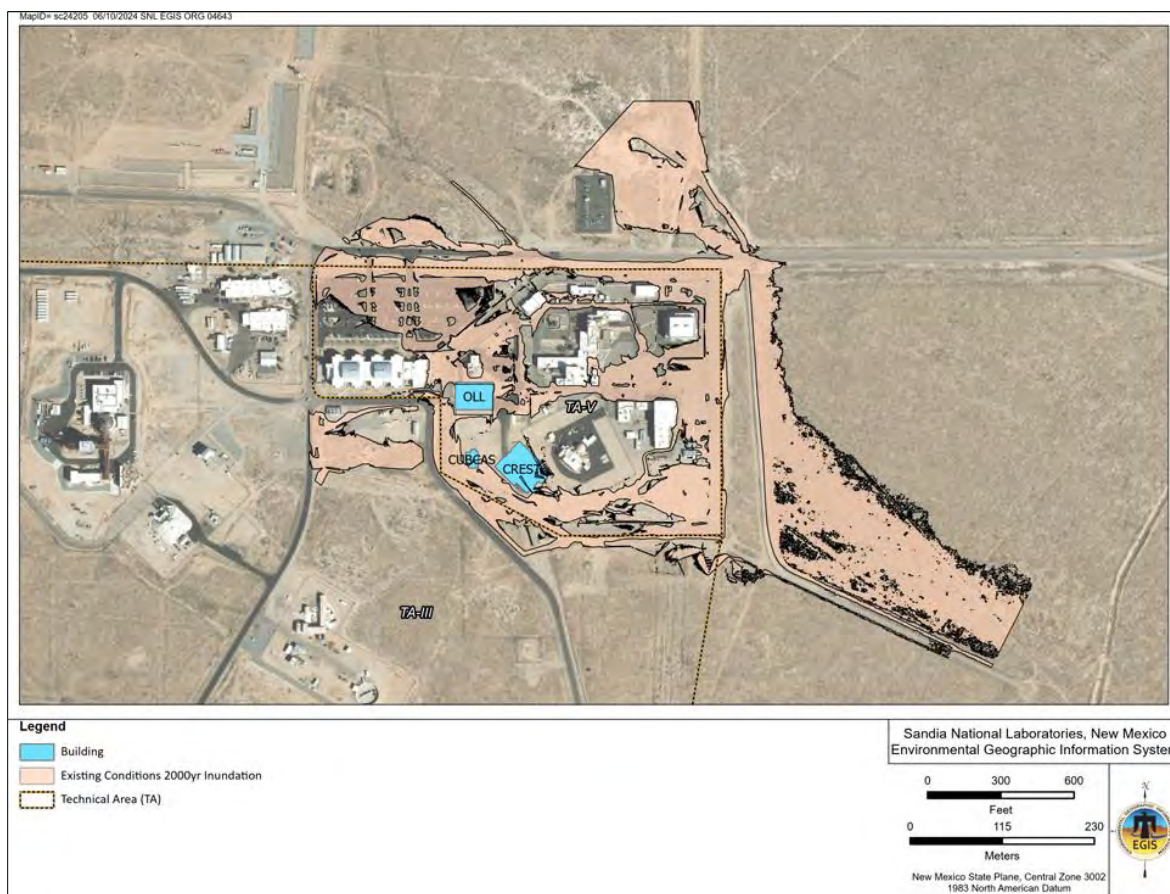
These improvements would protect the proposed buildings without negatively affecting existing structures. Figure A-10 and Figure A-11 show the predicted inundation extents at the CREST Complex with and without drainage improvements for a 2,000-year flood event (SNL 2021b).

¹⁹ The entire CREST Complex would total about 150,000 square feet, including the three modular office buildings.



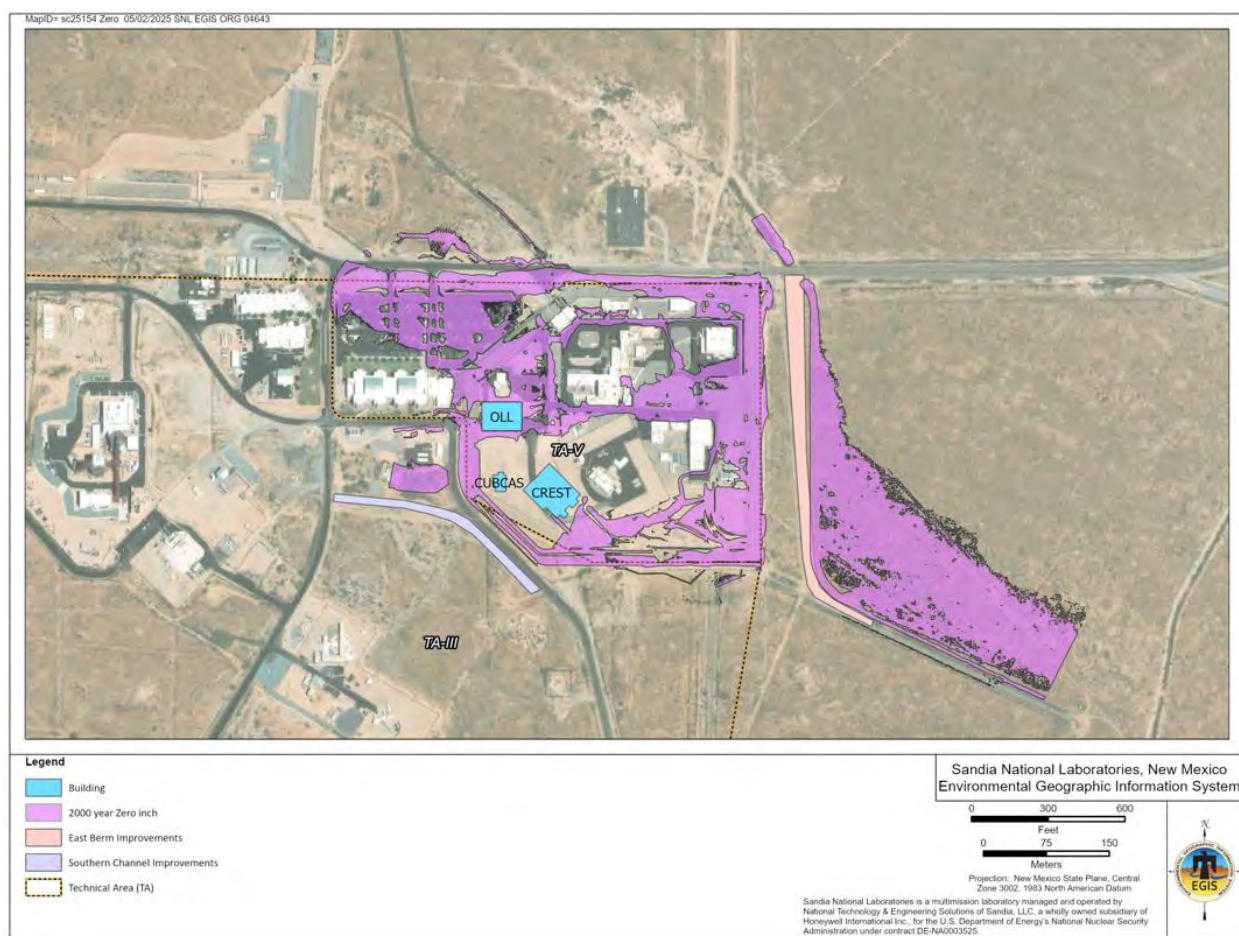
Source: Based on SNL 2022c and SNL 2024e.

Figure A-9. Recommended TA-V Drainage Improvements Plan View



Source: Based on SNL 2022c and SNL 2024e.

Figure A-10. Predictive Inundation Extents at the CREST Complex for the 2,000-Year Event without Drainage Improvements



Source: Based on SNL 2022c and SNL 2024e.

Figure A-11. Predictive Inundation Extents at the CREST Complex for the 2,000-Year Event with Drainage Improvements

Geotechnical Study. NNSA also prepared a detailed geotechnical study (SNL 2022d) of the proposed CREST Complex site. The purpose of that report is to characterize the seismic soil profile at the site and perform a preliminary screening-level probabilistic seismic hazard analysis (PSHA). The goal of the study was to (1) develop a better understanding of the geologic structure and seismic soil profile at TA-V, (2) develop the preliminary level of seismic hazard, and (3) identify additional characterization and analyses necessary to perform a fully compliant PSHA that can be used for development of site-specific seismic design criteria for existing and proposed nuclear facilities in TA-V.

As the report describes, TA-V is underlain by deep soil sediments extending to a depth of about 1,000 ft-bgs. Initial seismic velocity profiling at TA-V indicates the sediments have a shear wave velocity ranging from 1,250 feet to about 1,800 feet per second to a depth of 200 ft-bgs. The report identified several active or potentially active faults within 1–2 miles of TA-V capable of earthquakes of magnitude 6.5–7.2, with a recurrence interval of about 400 years (SNL 2022d).

NNSA will use the information in the geotechnical study to design the CREST Complex to meet the requirements of DOE-STD-1020-2016 (DOE 2016a).

Future Operations. Once operational in approximately 2034, both the ACRR and the CREST Complex may operate through approximately 2039. In 2039, operations at the ACRR are expected to cease, and that facility and other supporting facilities (AHCU, ACRR, SPR/CX) in TA-V could undergo DD&D. Figure A-12 depicts TA-V before the CREST Complex is built, as well as how the site would look after the CREST Complex becomes operational and the ACRR and other supporting facilities in TA-V undergo DD&D (SNL 2022b).



Source: SNL 2022b.

Figure A-12. TA-V Development Before and After CREST Complex

Key operational parameters associated with the SWEIS analysis of the proposed CREST Complex operations are as follows:

- This SWEIS conservatively assumes a 50 -percent increase in operations at facilities that emit radioactive material, and total radioactive air emissions are estimated at 11.8 curies (Ci) from the CREST Complex.
- About 37 CREST Complex workers would receive a measurable radiation dose. The dose to CREST Complex workers is estimated to be 178 millirem (mrem) per year.
- CREST Complex operations would generate about 8.6 m³ of routine low-level waste (LLW) annually (NTESS 2023a and NTESS 2023b).

Two potential fuel options for the reactor would be pursued: (1) legacy fuel reuse (i.e., the existing ACRR fuel is estimated to have a remaining lifetime of 40 years but could be reclad and reused for CREST)²⁰ and (2) new fuel. Possible alternatives to recladding the existing ACRR fuel onsite include:

- contracting with a commercial fuel supplier to build new fuel rods, or
- possibly contracting with another National Laboratory to reclad the existing ACRR fuel.

The new fuel would be the same fuel currently used in the ACRR reactor (UO₂-BeO) and Training, Research, Isotopes, General Atomics (TRIGA) fuel²¹ for the fuel-ringed external cavity, version II (FREC-II). The ACRR fuel recladding effort will ensure the continued viability of the facility's unique fuel by creating the capability to replace the external cladding on the existing ACRR fuel. Fuel recladding processes will be developed and demonstrated in 2024 and 2025 to establish the process equipment viability. Startup of the new AHCU fuel recladding capability is expected to take place in 2030, and recladding activities will continue in the AHCU in TA-V until the CREST Complex recladding capability comes online (NTESS 2023a).

The CREST Complex would be an HC-2 facility. The Pre-Conceptual Hazards Analysis (SNL 2018b) expects the CREST Complex would operate under many of the same radionuclide inventory limits as imposed upon the ACRR facility. For example, the higher provisional experiment material-at-risk (MAR) limit as described in Chapter 3, Section 3.2.2, and the normal operations experiment limit would be the same as the limits for the ACRR. Additionally, the facility MAR limit and normal operations MAR limit for the CREST Complex (20.6 kg and 2.61 kg of plutonium-239 [Pu-239] equivalent, respectively) would be the same as that for the ACRR.

²⁰ The UO₂-BeO fuel used in the ACRR main core has been in use since the ACRR began operations in 1978. Given that the ACRR is largely operated in pulse mode and the fuel can be used until burnup reaches 10 percent, the fuel has a theoretical expected lifetime of more than 200 years at the current usage rates (NNSA 2021).

²¹ TRIGA fuel is low-enriched uranium zirconium hydride (UZrH) used in TRIGA reactors, which are non-power nuclear reactors widely used at universities, government and industrial laboratories, and medical centers around the world (NNSA 2021).

The ACRR design-basis accident (DBA)-3 evaluated in Appendix D, Section D.3.5.1, conservatively assumes the 20.6-kg facility limit for its MAR.

According to the Pre-Conceptual Hazards Analysis (SNL 2018b), the proposed CREST design would include safety systems that add to or surpass those included in the ACRR design. Therefore, it stands to reason that potential accidents and consequences associated with the CREST Complex would be no more than those estimated for the ACRR.

NNSA anticipates the possibility that, under the Expanded Operations Alternative, the ACRR and the CREST Complex could be operating at the same time. The key difference in potential accident risk would be associated with an event that could affect both facilities. This would only occur in a potential seismic event. Therefore, for the potential site-wide seismic event discussed in Chapter 5, Section 5.14.5, this SWEIS assumes that the CREST Complex would experience the same potential consequences as analyzed for the ACRR.

Alternatives Considered but Eliminated from Detailed Analysis. Before proposing the CREST Complex analyzed in this SWEIS, NNSA prepared a detailed Analysis of Alternatives report (NNSA 2021) to examine technology and site alternatives, facility sizing possibilities, and fuel options. The Analysis of Alternatives report details the reasons why NNSA proposed the CREST Complex analyzed in this SWEIS, and the details of those reasons are not repeated here.

Design Evolution. Environmental reviews under NEPA are typically conducted early in project planning; therefore, for a major project, changes are expected from pre-conceptual to detailed design. However, fundamental design changes resulting in substantial changes to the environmental impacts analyzed in this SWEIS are not anticipated. Further, any design changes would rigorously adhere to the project's Safety Design Strategy, which includes a wide range of state-of-the-art safety codes and requirements to protect workers, members of the public, and the environment under routine and accident conditions. As described in the *Memorandum: Expectations for Safety-in-Design of the CREST Facility* (SNL 2022e), the Safety Design Strategy will guide the integration of these safety measures throughout the pre-conceptual, conceptual, preliminary, and final design phases for the CREST Complex.

A.3.4.9 Next Generation Pulsed Power Facility

Most of the yield from U.S. nuclear weapons comes from matter while it is in an HED state, where pressures exceed 1 million times that of the Earth's atmosphere and temperatures exceed those at the center of the sun. Thus, ensuring that the Nation's nuclear stockpile remains safe, secure, and effective requires an understanding of this unique physics regime. Outside of underground nuclear weapons testing, the only way to access the HED state is to use high-energy, high-power lasers or pulsed power machines. NNSA's Inertial Confinement Fusion Ignition and High Yield program today stewards three major HED capabilities: the "Z" pulsed power facility at SNL/NM, the NIF laser at Lawrence Livermore National Laboratory, and the Omega Laser Facility at the University of Rochester. These facilities collectively provide foundational science and engineering capabilities for the labs' nuclear deterrent mission. Data from these facilities inform design options for weapon LEPs, are used to validate models used in

weapon design, and help evaluate the survivability of U.S. weapons in hostile environments (SNL 2018c).

The achievement of multi-megajoule (MJ) fusion yields, and ultimately high yield (hundreds of MJ), is important to validating weapons models in the most extreme conditions generated in a nuclear explosion. This is critical in the evaluation of new and aging materials in the stockpile, as well as emerging weapon design concepts. While significant progress toward these goals has been made in the last 25 years, today's NNSA HED facilities will not achieve high yields in their present configurations, because they are unable to deliver sufficient energy to a target and compress it well enough to achieve the requirements for pressure, temperature, and time scale (SNL 2018c).

Achieving high yield is a need that remains today. High yield is well beyond the capabilities of NNSA's existing facilities, a fact acknowledged in the 1990s when the NIF was proposed as an intermediate step toward this goal. A 2016 study conducted for NNSA identified the need for a 10–30 MJ yield capability within the next 20 years for that facility or a successor facility to eventually achieve high yield (>500 MJ). Such a capability would address critical nuclear weapon primary and secondary physics questions and would produce large x-ray and neutron outputs that would help certify weapons survivability in hostile environments in larger test objects than possible today. The NNSA stockpile mission also requires the ability to achieve more realistic temperatures and pressures on large samples of hazardous materials at microsecond to nanosecond timescales (SNL 2018c).

There are practical challenges to achieving high yield. Although the NIF is the most powerful laser in the world, it is already three football fields in size. Therefore, it is unclear whether it is possible to credibly increase its energy coupling to targets (1–2 MJ) by more than a factor of 2 within its present footprint, and building an even larger laser facility is daunting. The other MJ-class HED facility, the Z-machine, today couples about 0.5–1 MJ to targets and was not designed as a facility capable of ignition and multi-MJ yields. However, there are multiple pulsed power technologies that can credibly deliver >10 MJ to a target within a facility footprint smaller than the NIF's. Consequently, the key recommendation of the 2016 NNSA study was to more rapidly assess whether pulsed power might be the best path to achieving 10–30 MJ within the next 20 years (SNL 2018c).

Without significant additional investment, the Nation needs a Next Generation Pulsed Power Facility (NGPPF). With ongoing sustainment efforts, the Z-machine is expected to operate into the 2030s. To move closer to achieving high yield without losing a pulsed power capability, an NGPPF would provide that capability at SNL/NM, where the NGPPF would be close to the weapons engineers who need test results and data, and where it would be accessible to physics design laboratories that also need the data. An NGPPF would also help the United States maintain parity with China, which today has a more heavily staffed pulsed power and high-energy laser program than the United States; has the world's second largest pulsed power facility; and has proposals to build two additional pulsed power facilities, both of which would be larger than the Z-machine today, as well as a large laser facility that would be slightly larger than the NIF today. A rendering of the NGPP is included in Figure A-13 (SNL 2018c).



Source: SNL 2022b

Figure A-13. Rendering of the NGPP

A.3.4.10 Microreactor

SNL/NM could integrate up to 50 megawatts electric (MWe) of advanced nuclear power technologies into the KAFB and SNL/NM energy portfolio. This would typically be achieved by a type of advanced reactor concept referred to as a “microreactor.” This concept is being developed to supply energy demands at much smaller scales than the traditional large power reactors deployed in the United States. A factory-manufactured, fully assembled, and pre-fueled microreactor between 5 and 10 MWe would arrive at SNL/NM and would be connected to the electric grid. This is a considerably lower power level than traditional large power reactors (e.g., 1,000 MWe). Based on some microreactor design concepts, it is possible that a microreactor could be powered by up to 400 kg of high-assay, low-enriched uranium tri-structural isotopic (TRISO) fuel. The microreactors would be swapped out when fuel is depleted. Capabilities exist within the DOE Complex to manage any depleted fuel from a microreactor. Other microreactor design concepts do not use TRISO fuel. Design-specific evaluations of radiological consequences due to an accident would be important because of the unique behavior of different fuel forms under accident conditions.

Microreactors have several features enabling them to achieve high levels of safety. They are generally considered to have highly reliable safety functions enabling them to control reactor power, cool the reactor fuel/core, and contain radiological material with very high safety margins. This is largely possible because of the use of inherent and/or passive safety to achieve various safety functions.

Inherent safety is achieved by eliminating or excluding hazards. This typically involves physical processes or phenomena making it physically impossible for certain hazardous conditions to occur. When specific hazards that could lead to a safety-significant condition cannot be physically excluded, the design of a nuclear power plant must provide safety systems. A safety system can achieve the safety function through either active or passive functions. An active safety system relies on external mechanical and/or electrical inputs to function (e.g., cooling fluids flow in a system through an electrically driven pump). A passive safety system, however, does not rely on external mechanical and/or electrical input to achieve its function – that is, a passive safety system typically relies on natural processes or phenomena to operate (e.g., cooling fluids flow because of buoyancy forces). Active safety systems generally have a higher

probability of not operating on demand relative to passive safety systems. Thus, passive safety is more reliable with respect to random unavailability.

Microreactors, in most cases, rely on passive safety systems. As such, they are generally considered to have large safety margins. Though the probability is low, there may be conditions in which an imbalance between energy generation in the fuel/core and energy removal leads to fuel overheating and causes the release of radiological material to the environment; for example, faults in some microreactor concepts associated with the reactor power regulation/control system, if not adequately contained, may result in the release of radiological material to the environment. A challenge in the assessment of the safety margin for these novel systems is the limited knowledge at present about the types of initiating events that could lead to release of hazardous material to the environment. While random faults or failures of engineered structures, systems, or components are generally believed to be less likely to occur than in currently deployed large power reactors, the performance of these novel systems under a range of external hazards (e.g., seismic events) has not been explored. There is no database of historical events for these novel systems that could inform safety/consequence evaluations.

For a microreactor facility with the potential for significant onsite consequences but that has steady-state power levels below 20 MW thermal, the facility could potentially be classified as HC-2. Such a facility would have sufficient nuclear material for a nuclear criticality event to be possible and require onsite emergency planning activities. The extent of radiological consequences for an HC-2 facility should not exceed 1 rem at 100 meters. A requirement for siting a microreactor at SNL/NM is that the accident consequences can be bounded by existing safety analyses for the ACRR and SPR facilities.

A.3.4.11 Wildland Fire Risk Reduction

Wildfire presents a persistent threat to SNL/NM personnel, structures, infrastructure, and the adjacent communities. The goals of forest management actions are to address ignition risk from roads, power lines, and other right-of-way infrastructure. The goals include using mitigation treatments to remove and thin the forest to align with BMPs. This is necessary because of historic fire suppression that drove dangerous fuel accumulation. Generally, this mitigation would strategically reduce dense, continuous fuels and wildland fire risk by creating a mosaic of openings, groups, and clumps and would occur in the Withdrawn Area. NNSA would collaborate with KAFB to develop a plan mimicking the *KAFB Wildland Fire Management Plan 2022–2023* (KAFB 2022a).

Once developed, the SNL/NM Wildland Fire Management Plan (SNL/NM WFMP) would establish policy, procedures, and responsibilities for wildland fire management, as well as outlining procedures, controls, and duties specific to fire suppression operations at SNL/NM. The SNL/NM Wildland Fire Program goals are expected to be similar to the following:

- Goal 1: Develop and maintain a robust wildland fire response and training/certification program for employees and other designated personnel to ensure the necessary skills and equipment to safely and efficiently execute the components of the SNL/NM WFMP.

- Goal 2: Fund SNL/NM's wildland lifecycle vehicle and equipment replacement program to effectively sustain, mitigate, prevent, respond to, and recover from wildland fires.
- Goal 3: Develop and then implement a robust collaborative fuels management program reducing the overall fire risk for the installation and surrounding communities, improving and restoring natural habitat, and removing invasive species from the landscape.

Once developed, the SNL/NM WFMP would describe risk management and suppression strategies, which are expected to include the following:

- Risk Management Strategies
 - Protect natural/cultural sites, surrounding communities, and other improvements outside SNL/NM.
 - Confine fires to existing blocks created by roads and other man-made barriers.
 - Protect all resources within SNL/NM.
 - Confine fire within designated fire management units.
 - Take measures to protect motorists. Such measures could include re-routing traffic and/or putting up caution signs on particular roads where needed, installing roadblocks, and using security forces personnel to control traffic.
- Suppression Strategies
 - Use roads and other man-made barriers as potential control lines.
 - Monitor fire behavior and smoke movement to ensure that life and property are not threatened.
 - When conditions permit, allow fires to burn and self-extinguish.
 - Patrol areas adjacent to the fire management unit perimeter for spot fires across control lines.
 - Use direct attack only if life or property is imminently threatened.

Except in the last 3 years, little to no effort has been made during the last 60 plus years to manage the fuels on KAFB and SNL/NM-managed lands. As a result, dangerously high overstock conditions exist in areas of KAFB and SNL/NM-managed lands. While the desired goal is to return fire to the landscape, much work must be done to create the conditions in which this can be accomplished with safety and control. Therefore, in the near term, under the *KAFB Wildland Fire Management Plan* (KAFB 2022a), most fuels treatment work would involve the use of manual or mechanical thinning, limbing and selective removal, or the application of approved herbicides. This SWEIS analysis focuses on these near-term actions, as they are considered reasonably foreseeable.

A.3.4.12 Open Burning/Open Detonation

NNSA treats certain SNL/NM RCRA explosive hazardous wastes by open burning at the TTU located in the northern part of TA-III, just west of TA-V. Hazardous waste treatment at the TTU is subject to an RCRA Facility Operating Permit (the RCRA Permit), issued by NMED in 1994 and renewed in February 2015.

Onsite treatment by open burning at the TTU is required because DOT forbids transport of the particular explosive waste generated at the adjacent LIHE Facility; therefore, NNSA must meet the RCRA treatment standard of deactivation onsite. The no-longer-explosive residue derived from treatment at the TTU consists of small amounts of ash left in the burn pan. The residue is a hazardous waste; it contains silver and thus is collected, containerized, and stored pending periodic removal to the Hazardous Waste Handling Unit (HWHU) for normal offsite hazardous waste disposal. The City of Albuquerque requires open burning permits and fugitive dust control permits for this activity (20.11.21 of the New Mexico Administrative Code [NMAC] and 20.11.20 NMAC). From 2017 through 2021, an average of 1,350 lb of explosive wastes were treated annually by open burning at the TTU (SNL 2023a).

The U.S Environmental Protection Agency (EPA) regulations promulgated under RCRA authorize the permitting of open burning/open detonation (OB/OD) units for the treatment of “waste explosives,” which are defined as “waste which has the potential to detonate and bulk military propellants which cannot be safely disposed of through other modes of treatment” (EPA 2002). In 2022, EPA issued a policy memorandum (EPA 2022) interpreting this regulation as authorizing the permitting and operation of OB/OD units for which no alternative mode of treatment is *safe* and *available*. The memorandum and proposed regulations issued in March 2024 (EPA 2024a) further clarified EPA criteria for “safe” and “available.” In determining whether a technology is safe, the following factors should be considered: (1) operational safety – whether the technology creates unreasonable risk of injury (i.e., by substantially increasing the likelihood of unintentional explosion) to personnel operating the unit, (2) monitorability – whether the technology must be monitorable both in terms of operational controls and effluents/emissions resulting from treatment operations to ensure protection of human health and the environment, and (3) toxic byproducts – whether the technology must be able to treat any toxic byproducts to levels protective of human health and the environment before release.

In identifying whether alternative technologies are available, EPA states that alternative treatment technologies should be considered, as well as other sources of information on technologies developed to date for certain waste streams (NASEM 2019 and EPA 2019). As discussed in this section, EPA has acknowledged there are certain circumstances and types of energetic waste that necessitate the use of OB/OD treatment based on safety hazards and other site-specific feasibility factors. The most important consideration when managing explosive waste streams is minimizing or eliminating, if possible, the danger and exposure to workers and the public from accidental ignition of the waste.

Site-specific factors should be considered when evaluating whether alternative technologies are available to safely treat SNL/NM’s explosive hazardous waste streams. As discussed in this

section, under DOT restrictions, some of SNL/NM's explosive hazardous wastes cannot be legally transported offsite for treatment. Thus, any alternative technology or technologies that can safely treat SNL/NM's explosive hazardous wastes would need to be installed onsite.

NNSA assessed alternatives to treatment by open burning in accordance with the requirements of the RCRA Permit (SNL 2023b). In this evaluation, NNSA screened a wide range of potential alternative technologies, apart from open burning at the TTU, that could be used to treat the explosive waste currently treated at the TTU, based on EPA guidance and additional SNL/NM-specific safety and health measures and considerations. Methods that are commercially available or under development were screened to determine whether they would be effective in treating the silver acetylide silver nitrate (SASN) wastes generated at SNL/NM currently treated by open burning at the TTU.

Based on the screening process, two thermal treatment technologies (Flashing Furnace and Tunnel Furnace) and one chemical treatment method (reaction with aqueous sodium thiosulfate pentahydrate) were identified as potential alternatives to open burning, and they were further evaluated. NNSA concluded that Flashing Furnaces and Tunnel Furnaces are currently not commercially available for treating explosives that will detonate; furnaces that could withstand detonation without damage would need to be developed, constructed, and tested. The evaluation also found that the chemical treatment method was not successful in completely deactivating the SASN explosive during initial tests, and NNSA concluded that additional testing of the chemical treatment technology is needed to determine whether the chemical treatment could be applicable to some SNL/NM waste (SNL 2023b).

None of the alternative treatment technologies is currently suitable for treating the SASN explosive wastes currently treated at the TTU. Therefore, for purposes of analysis, this SWEIS assumes that, after further development, one or more of the technologies described in this section would be implemented onsite under the Expanded Operations Alternative to potentially reduce explosive waste treatment through open burning.

With regard to the potential environmental impacts of implementing these technologies, without the availability of detailed designs, only the following general conclusions can be made:

- Each of these technologies would reduce the potential air emissions from the current OB/OD treatments performed at SNL/NM. However, for the purpose of the analysis in this SWEIS, no credit is taken for the expected reduction in OB/OD emissions, and the emissions are assumed to be consistent with those included in the No-Action Alternative.
- Noise generated from these alternative treatment technologies would be expected to attenuate before the public perceived it.
- The use of alternative treatment technologies instead of OB/OD would decrease the pollutants released to the atmosphere.
- The use of either type of furnace or an incinerator as an alternative treatment technology would increase fuel use.

- The potential land disturbance associated with implementing an alternative technology could exceed 1,000 square feet and would likely be in TA-III.

The SASN wastes treated at the TTU are only one type of explosive hazardous waste generated during operations at SNL/NM. Other types of explosive wastes are currently sent to offsite treatment, storage, and disposal facilities (TSDFs) for treatment, including treatment by OB/OD in accordance with the permits for each receiving facility. In the future, offsite TSDFs may no longer be available for treatment of SNL/NM explosive wastes. Therefore, for purposes of analysis, this SWEIS assumes that, after further development, one or more of the following technologies would be implemented onsite under the Expanded Operations Alternative to provide treatment of explosive waste:

- Contained detonation, which would involve the detonation of explosive wastes inside a steel chamber constructed to dampen the blast. After burning is complete, reactions would be suppressed to protect the integrity of the chamber. Particulates would be filtered from the detonation gases. This technology is best suited for small pieces of explosives, and residuals may transform into toxic or more complex compounds than those created when treating the same waste by open burning.
- Rotary kiln incinerator, which would be an enclosed incinerator treatment technology. The rotary kiln slowly moves waste from one end to the other and waste detonates or combusts within the heated chamber; therefore, only small amounts of explosive waste can be treated at one time. Emissions would be treated (i.e., filtered and/or neutralized) prior to release to the atmosphere.

With regard to the potential environmental impacts of implementing these technologies, without the availability of detailed designs, only the following general conclusions can be made:

- For the purpose of the analysis in this SWEIS, the emissions are assumed to be consistent with those included in the No-Action Alternative.
- Noise generated from these alternative treatment technologies would be expected to attenuate before the public perceived it.
- The use of alternative treatment technologies would decrease the pollutants released to the atmosphere.
- The use of either type of furnace or an incinerator as an alternative treatment technology would increase fuel use.
- The potential land disturbance associated with implementing an alternative technology could exceed 1,000 square feet and would likely be in TA-III.

A.3.4.13 Expanded Energy Projects

Expanded energy projects would enable SNL/NM to increase energy production and independence. Up to about 1,441 acres of land could be disturbed, mostly from PV projects. The largest project would be a Utility Scale PV + CSP Project (part of the Advanced Solar

Generation and Resiliency Deployment [ASGARD] initiative) (PV + CSP) that would involve about 1,200 acres. The proposed project includes a mixture of PV panels and energy storage, and a CSP system with a heliostat array and concentrating solar towers (either one tower up to 400 feet tall or up to three shorter towers up to 200 feet tall) to be sited on KAFB lands within the 1,750-acre footprints noted as Site B or Site C on Figure A-14 or in an area of similar vegetation type.

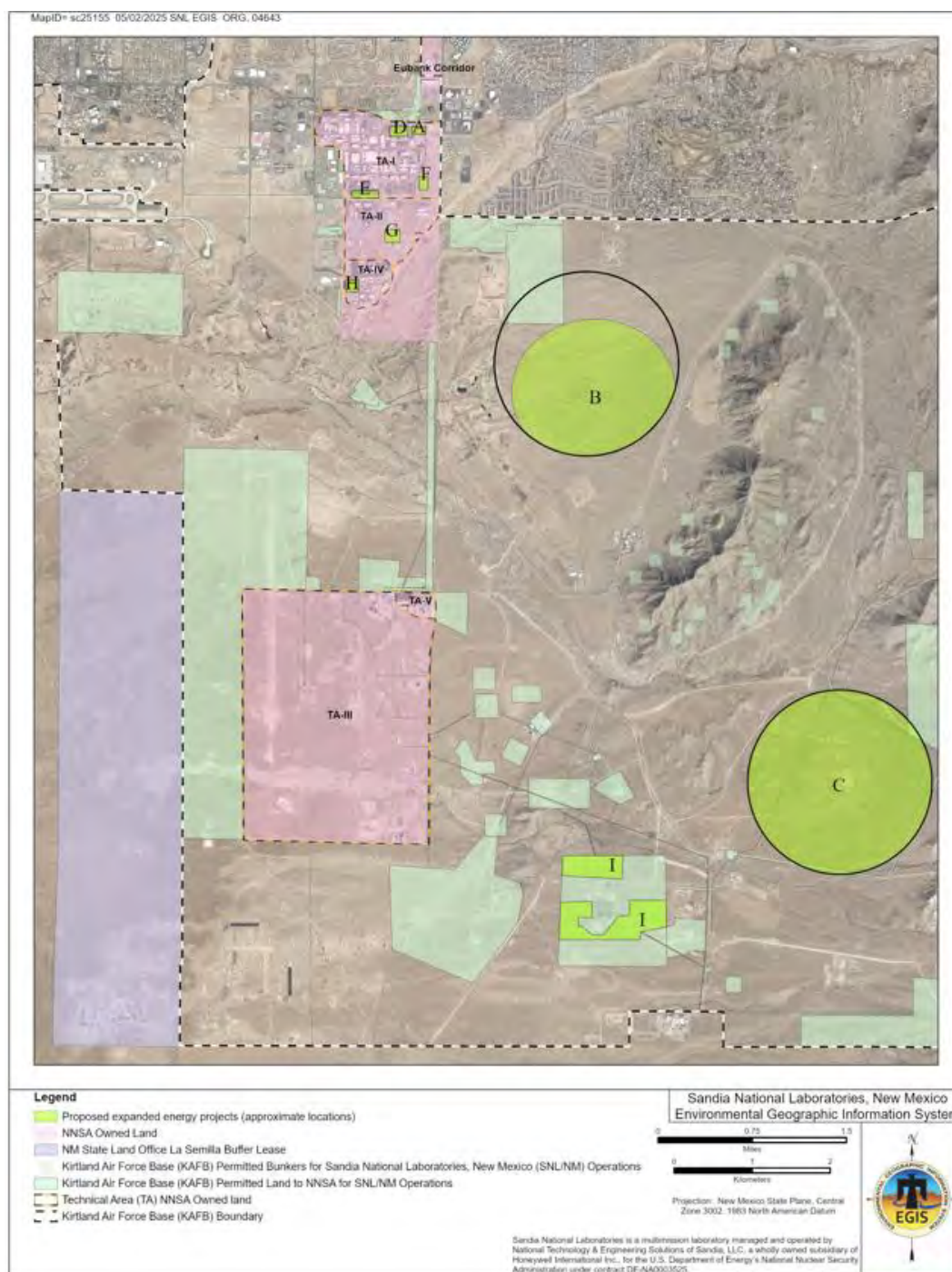


Figure A-14. Locations of Expanded Energy Projects

Figure A-15 provides an illustration of a typical power-tower CSP facility, which implements a surround heliostat field. However, the proposed CSP facility will likely implement a directional heliostat field facing south with a north-facing receiver on the tower. This effort provides resiliency to facilities at SNL/NM and KAFB and adds electricity production. The project will also include permitting activities (either a new permit or a consolidated permit) and partnership

with KAFB due to NNSA-owned land limitations. The proposed system has a capacity of up to 155 MW (SNL 2023c), with the CSP component representing a portion of this capacity.

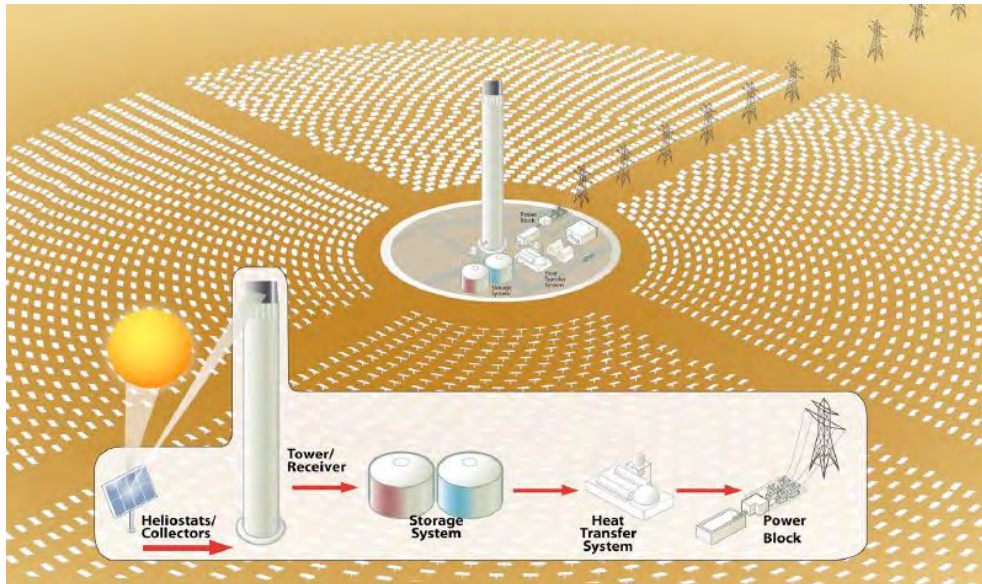


Figure A-15. Illustration of a Power-Tower PV + CSP Facility

In parallel with preparation of this SWEIS, SNL/NM is conducting technical analyses to evaluate the potential impacts of a PV + CSP system on the Department of the Air Force's (DAF's) operations at KAFB. The analyses' results will need to be compared against KAFB's equipment tolerances and operational requirements. This collaborative process, which may extend beyond the current SWEIS review process, will consider whether feasible design choices (system size, tower height, receiver configuration) can fully mitigate the impacts and will ultimately determine whether Site C is feasible.

The PV + CSP project would expand onsite energy production and improve energy resiliency and independence at SNL/NM and KAFB. The proposed project would combine PV panels and energy storage and either one tall heliostat tower (up to 400 feet) or up to three shorter towers (up to 200 feet) surrounded by heliostats. NNSA is discussing a partnership with KAFB that would require either a new permit or a consolidated permit, as there is not enough DOE-owned land for this project. The PV + CSP project will have a capacity of up to 155 MW (SNL 2023c). Additional information on the potential siting of the PV + CSP project at Site B and/or Site C is provided as follows.

Site B

NNSA has conservatively estimated that this site would require the following infrastructure upgrades to support the PV + CSP project:

- Electrical to Site B:
 - upgrade one existing substation;

- install one new substation;
 - upgrade transformers as needed; and
 - install up to 12,000 feet of new high-voltage power line with new poles.
- Water to Site B:
 - install a dedicated water storage tank and one pump station;
 - run new water lines up to 7,000 feet to support no more than 100 gallons per minute water use; and
 - dig a trench that is 3–4 feet wide and 6 feet deep for new water line construction.
- Sewer to Site B:
 - run sewer line 6,250 feet, including the crossing of the Tijeras Arroyo, which would require:
 - extra permits,
 - one or two pump stations to create lift needed in and out of the arroyo, and
 - run the line 2 feet deep below the bottom of the arroyo; and
 - dig a trench that is 3–4 feet wide and 6 feet deep for construction of the new sewer lines.

Site C

NNSA has conservatively estimated that this site would require the following infrastructure upgrades to support the PV + CSP project:

- electrical to Site C:
 - upgrade two substations;
 - install one new substation;
 - upgrade transformers as needed;
 - upgrade up to 17,000 feet of high-voltage power line; and
 - install 4,000 feet of new high-voltage line with poles.
- water to Site C:
 - run new water lines up to 6,700 feet; and
 - dig a trench that is 3–4 feet wide and 6 feet deep for the length of the new water lines.
- sewer to Site C:
 - run new sewer lines for up to 300 feet;
 - upgrade up to 6,250 feet of sewer line; and
 - dig a trench that is 3–4 feet wide and 6 feet deep for construction of a new and upgraded sewer lines.

As identified in Table A-12, other PV projects would be integrated into existing and new covered parking lots, and some would be standalone solar arrays. The total area of the PV arrays would be about 241 acres. Of this acreage, about 210 acres would represent new land disturbance not

already accounted for by other projects (SNL 2023c). As part of the 210 acres, installation and maintenance are proposed, via a public/private partnership, an Energy Sales Agreement, and/or an Energy Savings Performance Contract, for a PV solar field with energy storage and a microgrid on KAFB-permitted land at the NSTTF. This project will also include a permitting activity (either a new permit or a consolidated permit) along with partnering with KAFB. Figure A-14 depicts these project locations. In addition to these proposed projects, NNSA intends to evaluate other opportunities for roof-mounted solar PV with large open areas in serviceable areas of the TAs. About 440,000 square feet of gross roof space (about 10 acres of roof space) in TA-I may be used for rooftop PV. About 1 MW of power is produced per 4.5 acres of PV.

Table A-12. Expanded Energy Projects

Project Label on Figure A-14	Project Description	Size (acres)
A	Covered parking at new surface parking lot	3
B	PV + CSP project (ASGARD potential Site B)	1,200
C	PV + CSP project (ASGARD potential Site C)	
D	Covered parking at existing surface parking lot	6
E	Covered parking at existing surface parking lot	5
F	Covered parking at new surface parking lot	5
G	Covered parking at Fleet Services	8
H	Covered parking at existing surface parking lot and roof array at two new parking garages	4
I	PV and energy storage at NSTTF (Existing Solar Tower site)	210

Source: SNL 2023c.

Should energy technologies be viable, other additional expanded energy projects may include:

- A potential geothermal facility on KAFB property requiring up to a 30-acre plot with facilities including a geothermal plant, that would include 1–2 retention/evaporative pods, 2–3 tanks, turbines, utility connections (water, gas, electric, communications, etc.), and a water well if needed. This facility would operate 24 hours a day, 7 days a week and require up to 40,000 gallons of water per day.
- Geothermal exchange systems designed to use the thermal energy storage of geothermal fields. These systems would serve as a heat sink or heat source for chilled water and hot water production, depending on season and demand. The systems would be closed loop and vertical bore systems that circulate water through piping. Potential systems would have up to 8,050 bores that would be up to 600 feet deep and up to 1,000 feet long in multiple locations on SNL/NM-managed lands.

A.3.4.14 Integrated Natural and Cultural Resources Management Plan

NNSA proposes to develop and implement an Integrated Natural and Cultural Resources Management Plan (INCRMP) for SNL/NM. The INCRMP would provide strategies for SNL/NM to effectively manage natural and cultural resources and would provide information and direction for SNL/NM personnel as well as other federal, state, and local agencies and collaborating tribal entities. Although NNSA plans to address natural and cultural resources in

one integrated plan, NNSA may opt to develop two plans, one for natural resources and the other for cultural resources.

Scope: Natural resources proposed to be addressed in the INCRMP include plants and animals, threatened and endangered species, water, forested areas, recreation areas, and cultural resources. A guiding principle for the development of the INCRMP is to ensure sound ecosystem management for the protection of biological diversity. Cultural resources proposed to be addressed include prehistoric, historic aboriginal, historic non-aboriginal (historic sites and buildings), and traditional cultural properties. Through the INCRMP, NNSA would develop and implement a range of BMPs and mitigation measures to protect natural and cultural resources at SNL/NM.

NNSA plans to adapt the KAFB Integrated Natural Resources Management Plan (INRMP), which was updated in 2023 (KAFB 2023); supplement it with additional content as needed; and tailor it to address SNL/NM-specific activities and personnel. NNSA would develop its plan for SNL/NM in coordination with USFWS; New Mexico Department of Game and Fish (NMDGF); KAFB; the New Mexico State Historic Preservation Office (New Mexico SHPO); Tribal Historic Preservation Office (THPO); and other state, local, and tribal entities.

NNSA envisions the INCRMP would establish goals, identify concerns, and assign specific responsibilities and expectations for the management of resources.

Goals: Proposed goals for the INCRMP and examples of potential ways to meet them include:

- Establish and maintain a coordinated and supported integrated natural resources management program through effective communication, training, and resource information management.
- To meet this goal, the INCRMP would include measures to collect, update, and maintain natural resources information, including geographical information system data and associated databases, making them available for natural resources planning needs. Other measures may include education and awareness training for site personnel.
- Conserve and protect federal and state protected species, sensitive species, and other native wildlife and plants based on an ecosystem-management approach, while ensuring continued availability of lands for NNSA mission success.
- To meet this goal, the INCMRP would include a wide range of BMPs and mitigation measures, such as conducting surveys for federal and state listed, sensitive, and species of special concern and assessing survey needs periodically.
- To illustrate, the INCRMP may, for example, include annual monitoring of western burrowing owls, including surveys during nesting and migration periods. Analysis of survey results would inform the need for management actions, such as installing signage to protect owls from disturbance during critical periods, or the implementation of further management actions for burrowing owls, such as relocation.

- Plans to conduct periodic surveys for a variety of other species would be developed in coordination with KAFB, USFWS, and NMDGF. For example, periodic surveys of bats, birds, butterflies, predators, reptiles/amphibians, and other species would provide a baseline that could be used in tracking conditions and trends, which would inform implementation of management practices to be applied where and when needed.
- NNSA anticipates that coordination with KAFB may result in efficiencies, such as collaboration in conducting surveys for the same species in the same general region.
- Actively monitor and mitigate the effects of invasive species and pests to improve and protect natural and human resources at SNL/NM.
- To meet this goal, the INCRMP would include measures such as periodic invasive species monitoring and control plans using adaptive management approaches and the development and implementation of an integrated pest management plan.
- Ensure effective coordination with other resource management plans, such as plans for wildfire management and, if a separate plan is prepared, for cultural resources.
- To meet this goal, the INCRMP would include measures to ensure that forest resources are managed in coordination with all appropriate federal agencies (USFWS and Forest Service); state agencies (NMDGF); local agencies; and tribes, such as the Pueblo of Isleta. Coordination of forest and grassland resource management measures would help avoid potential conflicts among management goals.
- NNSA recognizes implementation of natural resource management measures may unearth or expose previously unknown cultural resources. For example, not all cultural resources may have been identified, and activities may inadvertently disturb such resources. It is also possible that natural resource management activities, such as forest management (e.g., brush control, other forms of fire threat reduction) or revegetation of disturbed areas, may reveal previously unidentified cultural resources. Many cultural resources are underground, and undiscovered cultural resources may be at risk from natural resources management activities, such as mechanical management or prescribed fire.
- Accordingly, NNSA expects, when appropriate, the INCRMP would direct consultation with the New Mexico SHPO and THPO, as well as state and federal agencies and tribal entities, before forest and other vegetation management measures are implemented. In any case, whether the cultural resources plan is integrated into the natural resources plan or developed as a standalone plan, natural resources and cultural resources plans would be coordinated with each other and with wildland fire risk reduction plans (discussed in Section A.3.4.11) and would be developed in collaboration with all relevant entities.

Potential Environmental Impacts. In developing its INRMP, KAFB prepared an EA and issued a FONSI (KAFB 2014). In the FONSI, KAFB concluded its INRMP would have long-term beneficial impacts on resources, that short-term impacts from implementation measures would be mitigated, that its INRMP would have no significant adverse environmental impacts, and that no further NEPA review was required. KAFB's INRMP addressed coordination of natural resource management measures with measures to protect cultural resources. Accordingly, NNSA

concludes its proposed INCRMP would result in essentially the same environmental impacts as the INRMP for KAFB and would have long-term beneficial impacts on natural and cultural resources. The same long-term beneficial impacts would be expected whether or not NNSA opts to prepare a standalone cultural resources management plan.

A.3.5 Comparison of the Potential Consequences of the Alternatives

This section provides supplemental information for comparing the potential consequences of analyzed alternatives. Table A-13 compares environmental consequences for SNL/NM's continued operation and potential impacts to environmental resources under the No-Action Alternative, Modernized Operations Alternative, and Expanded Operations Alternative. Table A-13 includes data for both construction and operations.

Table A-13. Comparison of Environmental Consequences

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Land Use and Airspace (refer to Section 5.2)		
Total permanent land development at SNL/NM will be 3,260 acres (24 percent of total land area). Site-wide development footprint will be about 6,102,728 square feet (3 percent more than the baseline). No change to current or future land use designation. Activities represent a continuation of existing land uses and will be compatible with existing and approved future land uses at and surrounding the site. No specific proposed projects or actions will result in changes, disruptions, or other impacts on the current use, management, or operational procedures of existing airspace.	Total permanent land development at SNL/NM would be 3,290 acres (24 percent of total land area). Site-wide development footprint would be about 6,989,308 square feet (15 percent more than the No-Action Alternative). No change to current or future land use designation. Activities represent a continuation of existing land uses and would be compatible with existing and approved future land uses at and surrounding the site. No specific proposed projects or actions would result in changes, disruptions, or other impacts on the current use, management, or operational procedures of existing airspace.	Total permanent land development at SNL/NM would be 3,577 acres (26 percent of total land area). Site-wide development footprint would be about 7,809,508 square feet (28 percent more than the No-Action Alternative). No change to current or future land use designation. The proposed Forest Service land transfer of all DOE withdrawn lands (4,595 acres) or partial land transfer with Forest Service retaining up to 315 acres would not result in current or future land use. Activities would be compatible with existing and approved future land uses at and surrounding the site. SNL/NM would expand UxS operations to include new air, ground, and water unmanned devices across all KAFB property, UAS flight “swarms,” and counterterrorism activities. Airspace would be governed by FAA certificates of authorization (COAs).
Visual Resources (refer to Section 5.3)		
No long-term change to Visual Resource Management (VRM) class.	No long-term change to VRM class.	KAFB-West’s short-term VRM class would change from II-III to IV and long-term VRM class would change from II-III to III-IV due to expanded energy projects, which would amplify existing visual impacts from SNL/NM operations on sites adjacent to residential developments and Pueblo of Isleta lands. All other areas have no long-term change to VRM class.

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Geology and Soils (refer to Section 5.4)		
Disturbance of about 13.1 acres of previously undisturbed soil will occur. No activities will cause significant ²² impacts on soil erosion, slope stability, subsidence, or liquefaction. Any new facility will be designed and constructed to meet seismic design criteria commensurate with the risk category requirements. Potential impacts from geologic hazards (i.e., seismic events) are discussed under “Accidents” at the end of this table.	Disturbance of about 42 acres of previously undisturbed soil would occur. No activities would cause significant impacts on soil erosion, slope stability, subsidence, or liquefaction. Any new facility would be designed and constructed to meet seismic design criteria commensurate with the risk category requirements. Potential impacts from geologic hazards (i.e., seismic events) are discussed under “Accidents” at the end of this table.	Disturbance of about 1,542.1 acres (73.8 acres for facilities; 3 acres for utility corridor; 1 acre for substation; 20 acres for roads; 3.3 acres for fence; and 1,441 acres for expanded energy projects and infrastructure) of previously undisturbed soil would occur. No activities would cause significant impacts on soil erosion, slope stability, subsidence, or liquefaction. Any new facility would be designed and constructed to meet seismic design criteria commensurate with the risk category requirements. Potential impacts from geologic hazards (i.e., seismic events) are discussed under “Accidents” at the end of this table.

²² In Table A-13 and where appropriate throughout this SWEIS, NNSA uses the term “significant”, as defined in DOE’s NEPA Implementing Procedures (DOE 2026).

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Water Resources and Hydrology (refer to Section 5.5)		
Surface Water: Minimal²³ impacts from (1) increased sediment load to surface water due to land disturbance; (2) increased surface water flow volumes due to impervious surfaces in localized areas; and (3) contamination from operations. SNL/NM will comply with NPDES stormwater requirements consisting of Construction General Permit (CGP), Municipal Separate Storm Sewer System (MS4), and Multi-Sector General Permit (MSGP) permits. Construction and operations would not affect floodplains. Groundwater: Compliance with federal regulations and implementation of mitigation measures would ensure minimal impacts on groundwater. Groundwater monitoring will continue under the No-Action Alternative to ensure existing remedy and remediation continues to be effective. Groundwater quality would be expected to continually improve.	Same as No-Action Alternative.	Same as No-Action Alternative.

²³ In Table A-13 and where appropriate throughout this SWEIS, NNSA uses the term “minimal” to describe potential non-zero impacts that are considered negligible because either (1) in context, the magnitude or intensity of the impacts would be too small to be significant, or (2) the impacts would be very small or slight in size or amount relative to defined standards for a resource. For example, “minimal” impacts include those that are indistinguishable from background, or so minor that they would neither destabilize nor noticeably alter any important attribute of an environmental resource. Refer to the detailed analysis in Chapter 5 for the basis of these summary descriptions.

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Air Quality (refer to Section 5.6)		
Bernalillo County is designated as an attainment area for all National Ambient Air Quality Standards (NAAQS). General conformity is not applicable. There would be minimal impact on air quality. Vehicular traffic and the use of construction equipment will generate most of the air emissions. No NAAQS would be exceeded. Impacts from radiological air emissions are addressed in Human Health.	Similar impacts as No-Action Alternative. Total non-construction-related air emissions are expected to increase by 29 percent compared to the No-Action Alternative, primarily from the increase in workforce commuting. No additional radiological emissions are expected. Impacts from radiological emissions are addressed in Human Health.	Similar impacts as No-Action Alternative. Total non-construction-related air emissions are expected to increase by 62 percent compared to the No-Action Alternative, primarily from the increase in workforce commuting. Radiological air emissions are expected to increase by about 35 Ci per year, with tritium and noble gases accounting for most of the increase. Impacts from radiological emissions are addressed in Human Health.
Noise (refer to Section 5.7)		
Noise impacts are expected to be similar to the impacts from existing noise generated by SNL/NM. Construction activities could generate ground-borne vibrations but are expected to be confined to the area immediately around equipment and not extend beyond the SNL/NM-managed lands. In most cases, UxS events are not perceptible outside of the KAFB boundary. In most cases, explosive events heard outside of the KAFB boundary resemble a dull thud or a short burst (less than 3 seconds). Given the remote location of the explosives test sites, noise is expected to attenuate prior to reaching residential areas.	Similar impacts as No-Action Alternative. There is no change in expected explosive frequency or magnitude of explosives used or the UxS frequency or use compared to the No-Action Alternative.	Similar impacts as No-Action Alternative. There is an expected increase of up to 50 percent in explosive frequency, with all types and sizes of explosives. While this would increase the number of noise and vibration events associated with explosive detonation, there is no change in the magnitude of any explosive event. This alternative also includes additional UxS operations, including increasing the number of flights and size of the swarms. Swarm size would be increased from 10 UAS to up to 100, which would increase the noise by an observer directly below. The number of UxS flights would increase by almost 60 percent compared to the No-Action Alternative. More frequent flights would not increase the magnitude of noise impact from the UxS.

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Biological Resources (refer to Section 5.8)		
Disturbance of 13.1 total acres (includes 5 acres of permanent staging area). Minimal impacts on vegetation, wildlife, and special status species.	Disturbance of 42.0 total acres. Minimal impacts on vegetation, wildlife, and special status species.	Disturbance of 1,542.1 total acres (73.8 acres for facilities; 3 acres for utility corridor; 1 acre for substation; 1,441 acres for expanded energy projects; 20 acres for roads; and 3.3 acres for fence). Moderate impacts primarily on grasslands, due to 1,441 acres for expanded energy projects. Significant impacts on grassland-reliant wildlife, bats, and migratory birds and raptors. Some impacts could be reduced by implementing a Bird and Bat Conservation Strategy (BBCS) and BMPs. Significant impacts on grassland-reliant and migratory special status species: bats, prairie dogs, and dozens of bird species. Some impacts could be reduced by implementing a BBCS and BMPs.
Cultural and Paleontological Resources (refer to Section 5.9)		
Minimal impacts on archaeological sites / Traditional Cultural Places. Ten historic buildings (NHPA historic properties) and other support facilities are scheduled for DD&D. Potential impacts on cultural resources would be avoided or reduced by locating projects in areas previously disturbed, rerouting construction to avoid resources, marking or fencing cultural resources that are at risk, and monitoring construction activities.	Similar impacts as No-Action Alternative. More than 40 historic buildings (NHPA historic properties) and other support facilities are scheduled for DD&D.	Potential for impacts on National Register of Historic Places (NRHP) qualities from development activities, of which up to 1,200 acres would be on less developed lands. Any construction in undeveloped areas would require archaeological survey and monitoring. If NRHP-eligible sites are encountered, further consultation may be required. DD&D would remove 100 historic buildings (NHPA historic properties).

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Traffic and Transportation (refer to Section 5.10)		
During operations, DD&D, and environmental remediation, SNL/NM would regularly transport radiological waste and other nuclear materials to and from the SNL/NM site. The estimated annual impacts of these shipments would be: • Dose to transport crews: 6.18 person-rem • Risk to transport crews: 0.0037 latent cancer fatalities (LCF) • Incident-free dose to public: 2.5 person-rem • Risk to Public: 0.0015 LCF • Accident Risk to Public: 0.00000054 LCF/yr • Non-radiological Risk (# of traffic-accident fatalities/yr): 0.00075	During operations, DD&D, and environmental remediation, SNL/NM would regularly transport radiological waste and other nuclear materials to and from the SNL/NM site. The estimated annual impacts of these shipments would be: • Dose to transport crews: 14.0 person-rem • Risk to transport crews: 0.0084 LCF • Incident-free dose to public: 16.2 person-rem • Risk to Public: 0.0097 LCF • Accident Risk to Public: 0.00000055 LCF/yr • Non-radiological Risk (# of traffic-accident fatalities/yr): 0.0011	During operations, DD&D, and environmental remediation, SNL/NM would regularly transport radiological waste and other nuclear materials to and from the SNL/NM site. The estimated annual impacts of these shipments would be: • Dose to transport crews: 18.1 person-rem • Risk to transport crews: 0.011 LCF • Incident-free dose to public: 17.7 person-rem • Risk to Public: 0.011 LCF • Accident Risk to Public: 0.00000082 LCF/yr • Non-radiological Risk (# of traffic-accident fatalities/yr): 0.0015
Infrastructure (refer to Section 5.11)		
The existing infrastructure (utilities) will be adequate. Electrical capacity may become a limiting factor in the future. SNL/NM is currently conducting a site-wide electrical infrastructure study to identify system limitations and recommend the necessary upgrades to support future growth and ensure reliable power delivery.	Electrical capacity would become a more critical limiting factor, as peak energy usage would utilize 53% of existing capacity. Water and natural gas increases can be accommodated by existing systems. Sanitary wastewater discharge remains well below permitted discharge rate.	Due to increased onsite electrical power generation, peak energy usage would only increase 17 percent, lowering impact on existing capacity from the Modernized Operations Alternative. Water and natural gas increases can be accommodated by existing system. Sanitary wastewater discharge remains well below permitted discharge rate.
Materials Management and Waste Management (refer to Section 5.12)		
Construction, environmental remediation, DD&D, and operations will generate the following projected annual quantities of waste: LLW (m³/yr): 93.9 MLLW (m³/yr): 93.8 TRU waste (m³/yr): 1.4 Hazardous (MT/yr): 353 ACM (MT/yr): 253 Infectious waste (MT/yr): 2.8 Chemical waste (MT/yr): 296.4 Classified hazardous waste (MT/yr): 8.1 Classified non-hazardous waste (MT/yr): 10.2 Non-hazardous solid (MT/yr): 5,450	Construction, environmental remediation, DD&D, and operations would generate the following projected annual quantities of waste: LLW (m³/yr): 93.9 MLLW (m³/yr): 93.8 TRU waste (m³/yr): 1.41 Hazardous (MT/yr): 574 ACM (MT/yr): 474 Infectious waste (MT/yr): 2.8 Chemical waste (MT/yr): 296.4 Classified hazardous waste (MT/yr): 8.1 Classified non-hazardous waste (MT/yr): 10.2 Non-hazardous solid (MT/yr): 6,450	Construction, environmental remediation, DD&D, and operations would generate the following projected annual quantities of waste: LLW (m³/yr): 250 MLLW (m³/yr): 140.1 TRU waste (m³/yr): 2.1 Hazardous (MT/yr): 1,069 ACM (MT/yr): 922 Infectious waste (MT/yr): 4.2 Chemical waste (MT/yr): 444.6 Classified hazardous waste (MT/yr): 12.1 Classified non-hazardous waste (MT/yr): 53.0 Non-hazardous solid (MT/yr): 9,990

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Human Health and Safety (refer to Section 5.13)		
Non-radiological impacts: • Lost days due to injury/illness per year: 384 • Number of occupational fatalities per year: 1.0 Radiological impacts: <u>Public</u> Maximally exposed individual (MEI) risk (LCF): 0.0000000039 Population risk (LCF): 0.000014 <u>Workers</u> Collective annual radiological dose to workers (person-rem): 2.38 Total annual radiological risk to workers (LCFs): 0.0014	Non-radiological impacts: • Lost days due to injury/illness per year: 440 • Number of occupational fatalities per year: 1.1 Radiological impacts: <u>Public</u> MEI risk (LCF): 0.0000000099 Population risk (LCF): 0.00002 <u>Workers</u> Collective annual radiological dose to workers (person-rem): 9.5 Total annual radiological risk to workers (LCFs): 0.0057	Non-radiological impacts: • Lost days due to injury/illness per year: 524 • Number of occupational fatalities per year: 1.3 Radiological impacts: <u>Public</u> MEI risk (LCF): 0.000000015 Population risk (LCF): 0.00003 <u>Workers</u> Collective annual radiological dose to workers (person-rem): 21.1 Total annual radiological risk to workers (LCFs): 0.013
Accident Analysis and Intentional Destructive Acts (refer to Section 5.14)		
Dose and LCF Totals: (average meteorology) MEI dose (rem): 0.21 MEI LCF: 0.000126 Offsite population dose (person-rem): 535 Offsite population LCF: 0.32 Co-located worker dose (rem): 2.44 Co-located worker LCF: 0.00146 Annual Risk Totals for Design -Basis Seismic/Fire-Involved Facilities: MEI (LCF): 0.000000026 Offsite population (LCF): 0.0001 Co-located worker (LCF): 0.00000073	Dose and LCF Totals: (average meteorology) MEI dose (rem): 0.21 MEI LCF: 0.000126 Offsite population dose (person-rem): 535 Offsite population LCF: 0.32 Co-located worker dose (rem): 2.44 Co-located worker LCF: 0.00146 Annual Risk Totals for Design Basis Seismic/Fire-Involved Facilities: MEI (LCF): 0.000000026 Offsite population (LCF): 0.0001 Co-located worker (LCF): 0.00000073	Dose and LCF Totals: (average meteorology) MEI dose (rem): 0.21 MEI LCF: 0.000126 Offsite population dose (person-rem): 535 Offsite population LCF: 0.32 Co-located worker dose (rem): 2.44 Co-located worker LCF: 0.00146 Annual Risk Totals for Design Basis Seismic/Fire-Involved Facilities: MEI (LCF): 0.000000026 Offsite population (LCF): 0.0001 Co-located worker (LCF): 0.00000074
Socioeconomics (refer to Section 5.15)		
Direct SNL/NM Jobs: 14,378 Indirect Jobs: 5,175 Total Annual Value Added to the Region of Influence (ROI) Economy (Millions): \$2,633.2 Schools: No change in demand; no effect on school services. Housing: No change in vacancy; median price increases anticipated unrelated to NNSA activities	Direct SNL/NM Jobs: 16,460 Indirect Jobs: 5,924 Total Annual Value Added to the ROI Economy: (Millions): \$3,013.8 Schools: Minimal enrollment increase; no effect on school services Housing: Adequate availability; median price increases anticipated unrelated to NNSA activities	Direct SNL/NM Jobs: 19,750 Indirect Jobs: 7,107 Total Annual Value Added to the ROI Economy: (Millions): \$3,616.2 Schools: Minimal enrollment increase; no effect on school services Housing: Adequate availability; median price increases anticipated unrelated to NNSA activities

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Surrounding Population Considerations: No disproportionate and adverse impacts on at-risk populations are anticipated. Refer to Table 5-64 for detailed information	Surrounding Population Considerations: No disproportionate and adverse impacts on at-risk populations are anticipated. Refer to Table 5-64 for detailed information	Surrounding Population Considerations: No disproportionate and adverse impacts on at-risk populations are anticipated. Refer to Table 5-64 for detailed information

A.4 EXISTING ENVIRONMENT – SUPPLEMENTAL INFORMATION

This section provides information that supplements and supports the material presented in Chapter 4 of the main document.

A.4.1 Introduction

Table A-14 includes DD&D activities conducted onsite each year since 2005.

Table A-14. Annual DD&D Since 2005

Year	Number of Structures	Number of Square Feet	Area
2005	3	2,232	KAFB Permitted ^a
2006	31	75,013	TA-I, TA-III, KAFB Permitted
2007	24	20,819	TA-I, TA-III, TA-IV, KAFB Permitted
2008	20	148,566	TA-I, TA-III, TA-V, KAFB Permitted
2009	29	42,678	TA-I, TA-II, TA-III, KAFB Permitted
2010	15	41,137	TA-I, TA-II, TA-III, TA-IV
2011	9	32,395	TA-I
2012	12	4,341	TA-I, TA-III, KAFB Permitted
2013	5	1,417	TA-I, TA-II, TA-III, KAFB Permitted
2014	4	4,257	TA-IV
2015	5	13,871	TA-I, TA-III, TA-V, KAFB Permitted
2016	12	2,323	TA-I, TA-II, TA-III
2017	9	15,021	TA-I
2018	8	8,090	TA-I, TA-III, KAFB Permitted
2019	5	1,987	TA-I, TA-III, KAFB Permitted
2020	2	668	KAFB Permitted
2021	1	6,480	KAFB Permitted
2022	7	12,487	TA-I
Total	201	433,782	
Average Annual	11	24,099	

a. “KAFB Permitted” refers to onsite lands outside of the five defined TAs, also referred to as “KAFB-West” and “KAFB-East” as described in Section 4.2.2.7.

Table A-15 details the development density of each TA within SNL.

Table A-15. TA Development

TA	Acres	Buildings	Square Feet	Development Density ^a
I	356	225	4,361,000	12,250 ft ² /acre
II	256	48	336,000	1,313 ft ² /acre
III	1,865	132	279,000	150 ft ² /acre
IV	316	111	740,000	2,342 ft ² /acre
V	28	28	208,000	7,429 ft ² /acre
Total	2,821	544	5,924,000	2,100 ft²/acre

a. Development density equals ft² divided by acreage.

A.4.2 Land Use and Airspace

This section is reserved.

A.4.3 Visual Resources

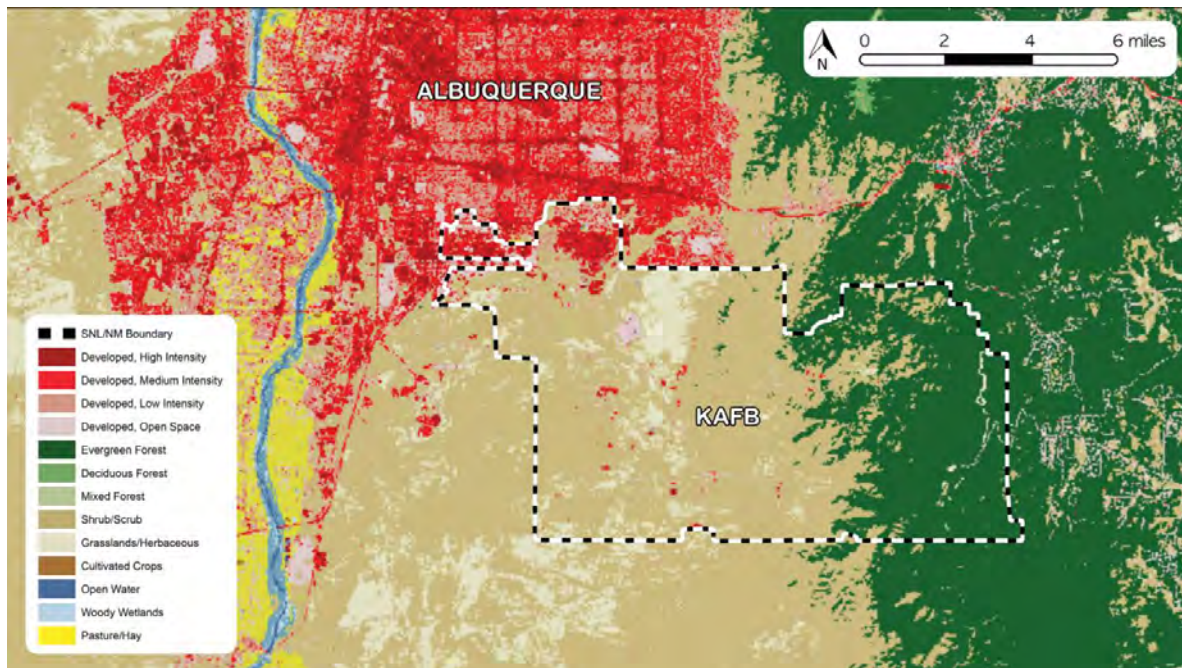
Views from offsite areas to the developed portions of SNL/NM appear as semi-developed and semi-industrial with buildings, internal roadways and pathways, and open space. An example view is provided in Figure A-16.



Source: Aerial Photo Provided by NNSA.

Figure A-16. Bird's-Eye View from TA-II Looking North-Northeast Showing East Side of TA-I with Sandias in Background

The U.S. Geological Survey (USGS) maintains the National Land Cover Database (NLCD), which inventories the existing character of a landscape, level of development, and degree of contrast. This SWEIS used the NLCD to prepare Figure A-17, which shows that SNL/NM's footprint is marked by areas of both high- and medium-intensity development and undeveloped areas of evergreen forests, shrublands, and grasslands that serve as a security, safety, and visual buffer zone.



Source: MRLC 2023.

Figure A-17. NLCD Land Cover Map

The majority of land managed by SNL/NM onsite is largely undeveloped and isolated, consistent with a visual resource management (VRM) Class I or II rating. The developed areas present a high level of contrast between the high desert landscape and the physical improvements to the land and are more consistent with VRM Classes III and IV. Given SNL/NM’s immense footprint and diverse development, a single VRM class rating would not be appropriate; instead, a rating was assigned to distinct areas as shown in Table A-16. Table A-16 outlines SNL/NM’s land areas by existing VRM class; the classes range from I to IV.

Table A-16. Existing VRM Class by Area Type

Area	Existing VRM Class	Degree of Contrast	Description
TA-I, TA-II, TA-IV	IV	High	TA-I, TA-II, and TA-IV are in densely developed areas classified as having a high public value based on their visibility from offsite locations. These areas are the oldest and most heavily developed portion of SNL/NM with high- and medium-intensity development. There are major modifications to the landscape that dominate views. The proximity of these TAs to the Albuquerque metropolitan area can impact the public view. The existing natural environment has been altered by decades of high-intensity development, and the built environment dominates the natural setting. These TAs are also classified as having “indistinctive” scenic attractiveness and “low” existing scenic integrity.

Area	Existing VRM Class	Degree of Contrast	Description
TA-III, TA-V	III	Moderate	TA-III and TA-V are medium-intensity development located farther into the site's interior. The areas are second in development concentration to TA-I, TA-II, and TA-IV. TA-III and TA-V are generally classified as having a low public value due to their more removed location. TA-V is located in the northeast corner of TA-III. The natural grass and shrublands are still present, though interrupted by facility and infrastructure. The area is also classified as having "indistinctive" scenic attractiveness and "low" existing scenic integrity. TA-III and TA-V are located farther into the site's interior with distance mitigating some of the visual effects from its development. Although there are areas within these TAs untouched and left in their natural state, large-scale facilities and infrastructure may attract attention.
KAFB-West	II-III	High	KAFB-West features low-to-medium intensity development, munitions and waste storage, and patchy infrastructure. Its sprawling geographic area encompasses the entire western portion of the site, from the northern boundary to the southern end. The natural environment and landscape are primarily intact with pockets of high-intensity developments. The most notable facility in KAFB-West is the NSTTF located in the south close to the Pueblo of Isleta. The Solar Tower is visible from offsite locations on the rangelands of the Pueblo of Isleta. Because of the visibility of this key facility from offsite, it was assigned a VRM Class of III. The remainder of the KAFB-West was assigned a Class II rating.
KAFB-East	II	Weak to None	KAFB-East is geographically sprawling, spanning the eastern, mountainous portion of KAFB. Due to the nature of its landscape, KAFB-East is mostly undeveloped, with large concentrations of evergreen forests and shrublands. There are few pockets of low-intensity development scattered about this planning area. The natural site character is largely preserved, although islands of development present moderate-to-weak degrees of contrast. Although the degree of contrast is moderate in places, KAFB-East was assigned a VRM Class II rating because of the overall limited and dispersed development, interior siting, and intervening topography obscuring the built improvements from offsite view.
La Semilla Buffer Zone	I	None	The La Semilla Buffer Zone is a wholly undeveloped parcel to the west of KAFB offsite. The existing environment is preserved with no facilities or infrastructure as a contrasting feature on the landscape.
Offsite Locations in Albuquerque	IV	High	Offsite facilities are typically clustered near KAFB within heavily developed sections of Albuquerque. Albuquerque's urban landscape is characterized by high-intensity development with major modifications to the natural landscape.

A.4.4 Geology and Soils

The SNL/NM area is structurally complex, with several major regional faults traversing the area (Figure A-18). These faults are mostly western-dipping normal faults that exhibit down-to-the-west displacement along the fault planes. The northeast-trending Tijeras Fault zone bisects the SNL/NM and KAFB area and exhibits a long history of strike-slip movement (SNL 2003). The zone consists of several regional normal faults including the Sandia, Hubbell Spring, and

Manzano faults. The Hubbell Spring Fault is particularly important to the TA-III/TA-V areas because it has been active as recently as the 1930s when movement along the fault curtailed the water flow from nearby springs (SNL 2020a).

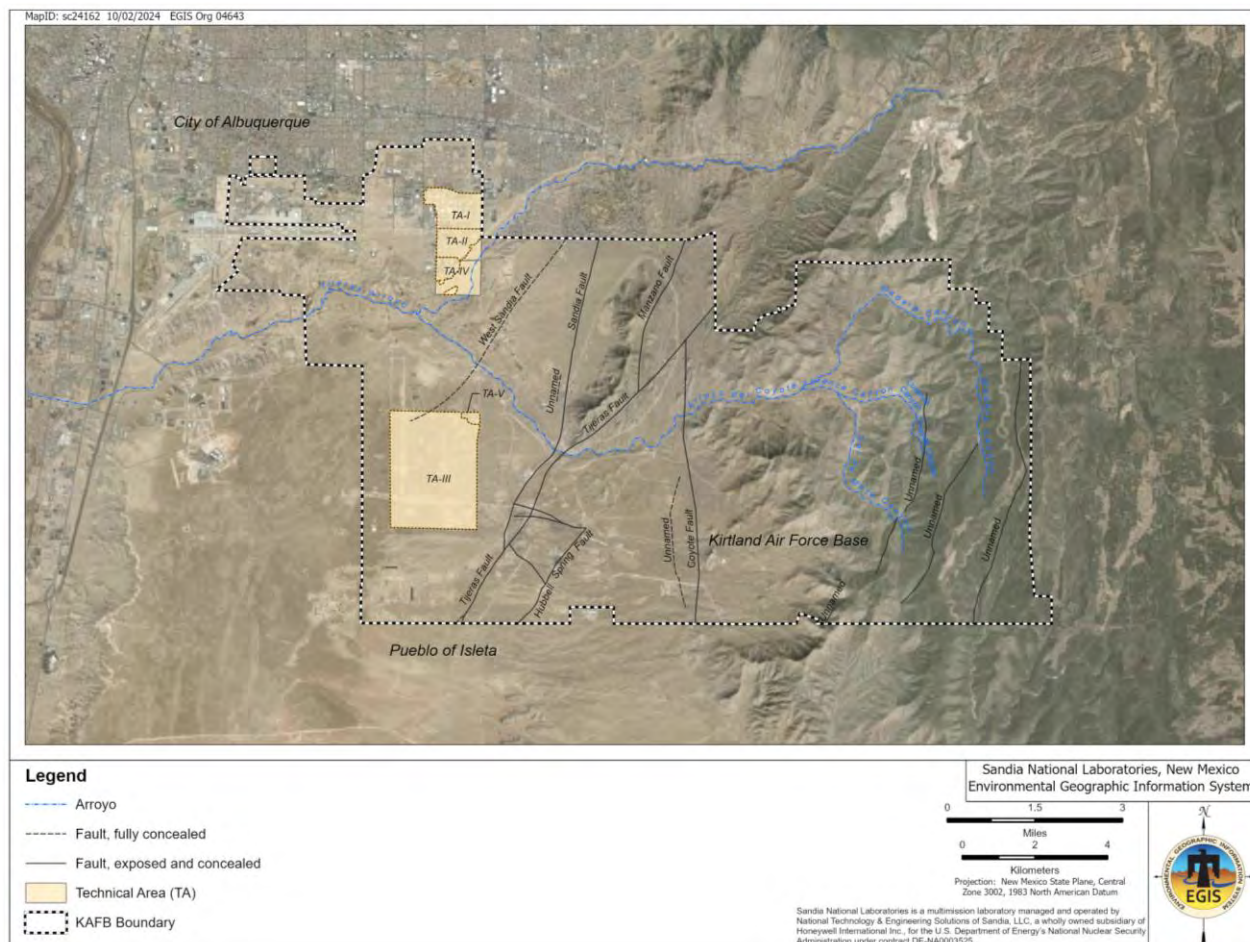


Figure A-18. General Depiction of Fault Zones Near SNL/NM

A.4.5 Water Resources and Hydrology

As shown in Figure A-19, SNL/NM is located within three separate watersheds (drainage areas):

- Tijeras Arroyo watershed,
- unnamed closed basin, and
- Hubbell Spring watershed.

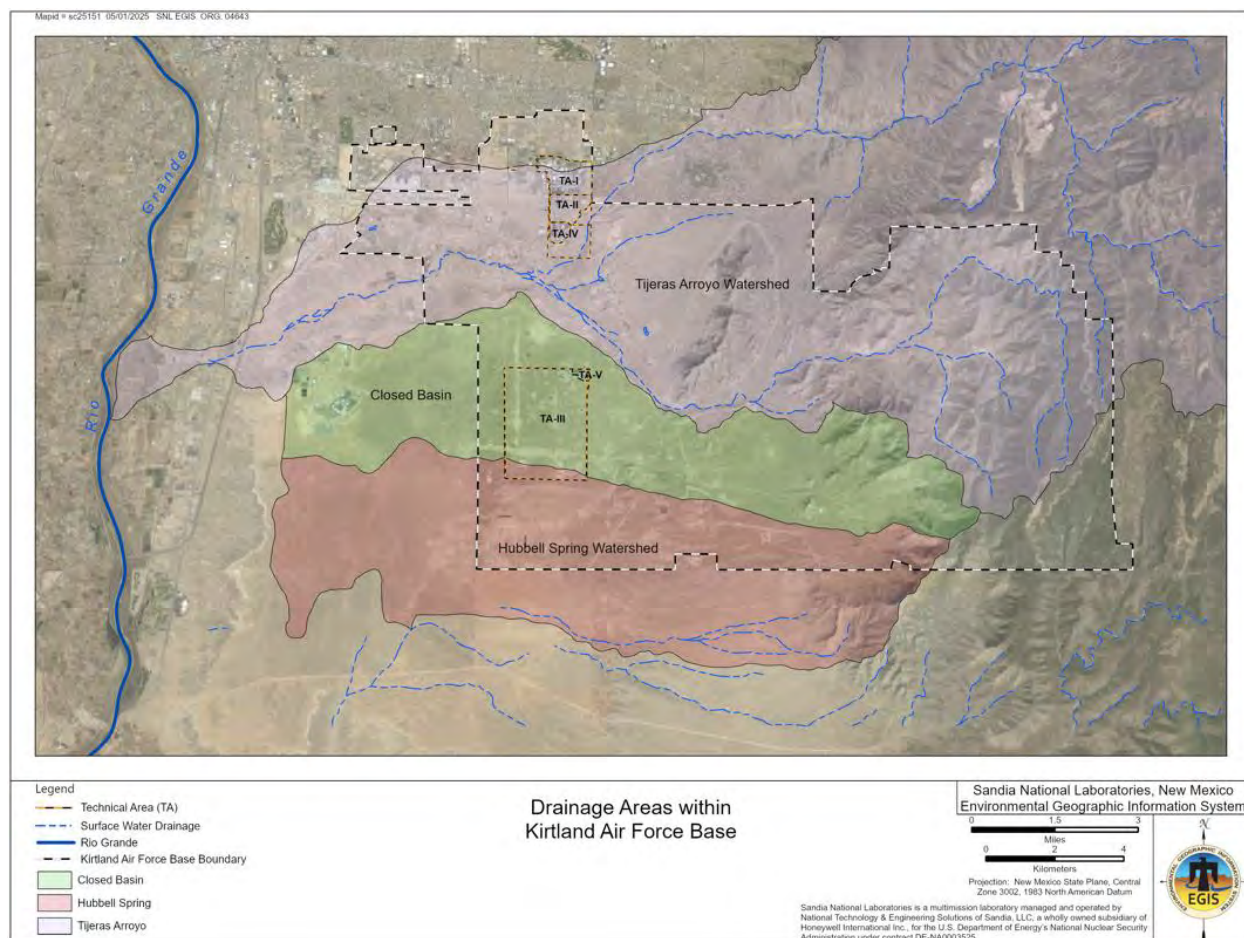


Figure A-19. Drainage Areas within KAFB

The major surface drainages at SNL/NM are Tijeras Arroyo and its tributary Arroyo del Coyote (BGW 2002). Both of these arroyos are located in the Tijeras Arroyo watershed. Tijeras Arroyo originates in Tijeras Canyon and runs coincident with the Tijeras Fault for several miles northeast of KAFB before deviating to the southwest and crossing SNL/NM TA-II and TA-IV (refer to Figure A-20 and Figure A-22).

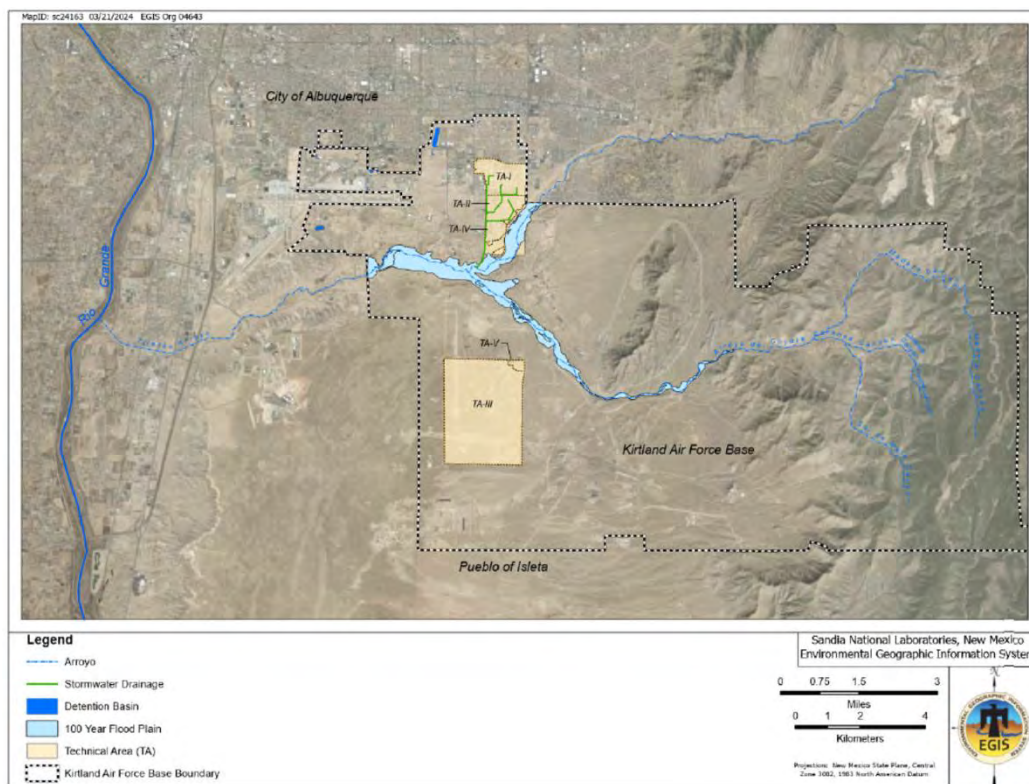
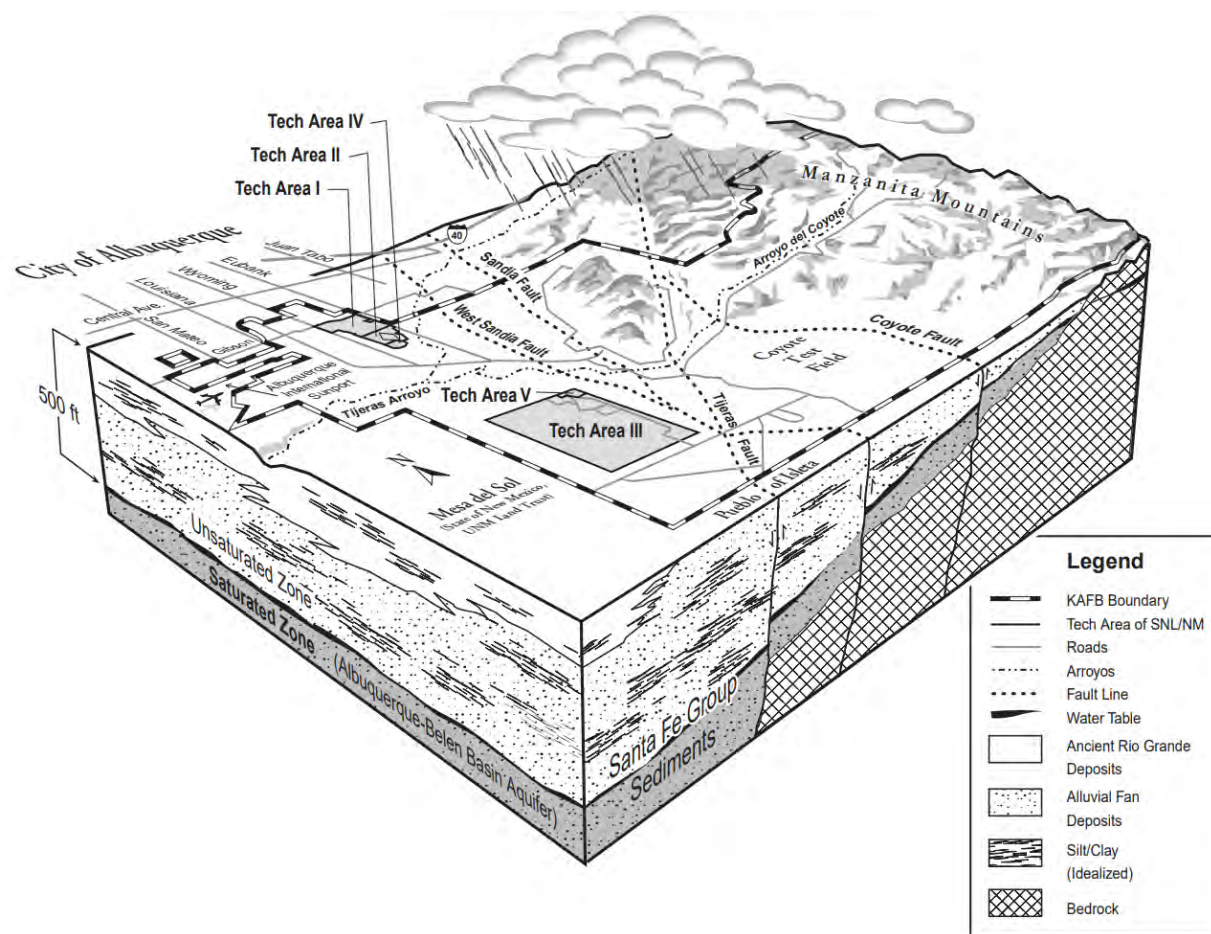


Figure A-20. Tijeras Arroyo and Arroyo del Coyote

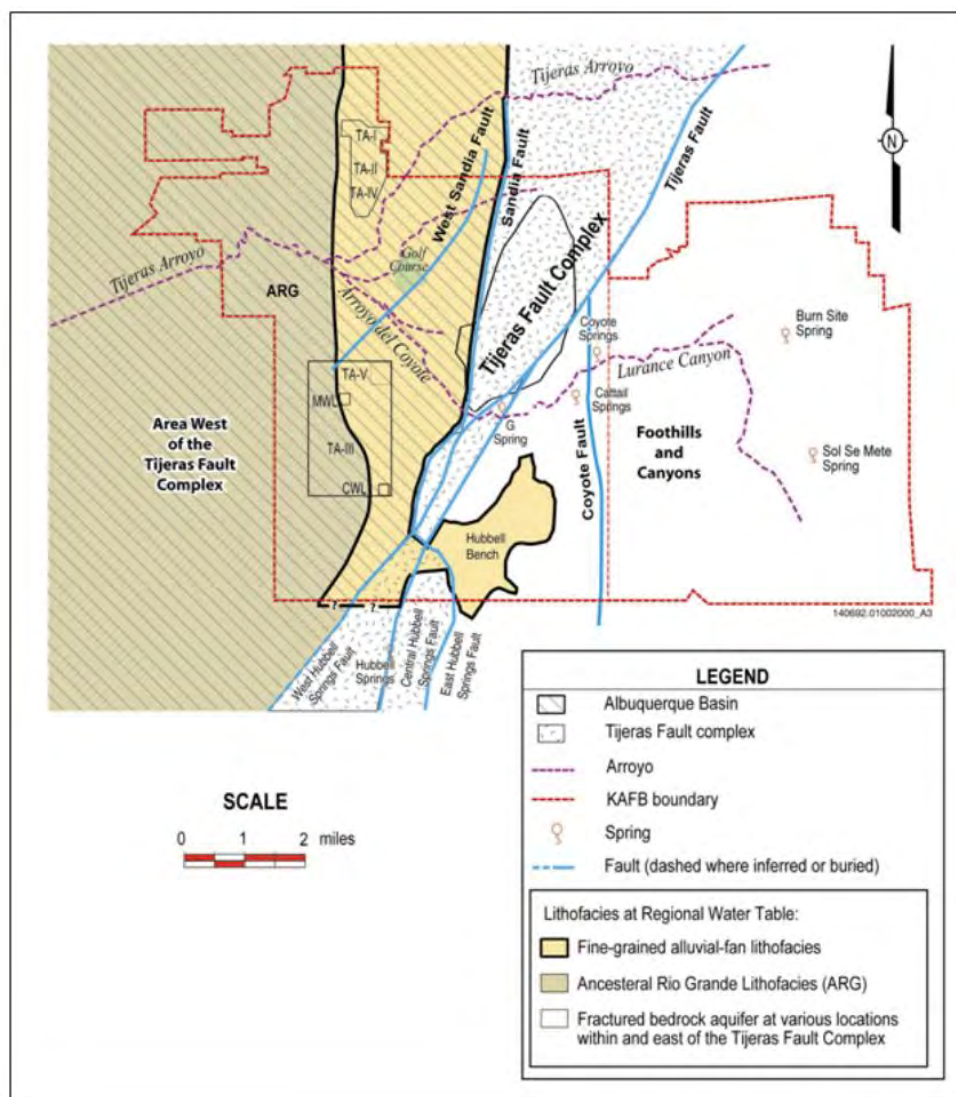
A conceptual rendering of the groundwater system underlying KAFB is presented in Figure A-21.



Source: DOE 1999.

Figure A-21. Conceptual Diagram of Groundwater System Underlying KAFB

The KAFB property that includes SNL/NM-managed lands is divided into three distinct hydrogeologic areas primarily controlled by faults, as shown in Figure A-22. Moving from west to east the areas are (1) the Albuquerque Basin, (2) the Tijeras Fault Complex, and (3) the foothills and canyons region.



Source: SNL 2012a.

Figure A-22. Hydrogeologic Regions Primarily Controlled by Faults

SNL/NM personnel conduct groundwater sampling at six monitoring well networks. The site-wide network is designated as the Groundwater Monitoring Program, and SNL/NM well locations are scattered throughout and along the perimeter of KAFB in areas not specifically affiliated with Solid Waste Management Units (SWMUs) or AOCs.

Groundwater monitoring is also performed at three AOCs (i.e., TA-V Groundwater, TAG, and BSG) as required by the 2004 Consent Order (NMED 2004). The MWL underwent corrective action and required groundwater monitoring is performed under the MWL LTMMP (SNL 2012a). The CWL is a closed, regulated unit with groundwater monitoring performed under post-closure care requirements.

The following sections summarize the monitoring networks and groundwater sampling results for CY 2022. Details of the groundwater investigations can be found in published Annual Groundwater Monitoring Reports available at <https://www.sandia.gov/news/publications/environmental-reports/>.

A.4.5.1 Groundwater Monitoring Program

The purpose of reviewing the Groundwater Monitoring Program network is to establish background quality and gain an understanding of the general hydrogeologic system beneath SNL/NM, along the perimeter of KAFB and areas not specifically associated with compliance monitoring at the three SNL/NM groundwater AOCs, the MWL, or the CWL.

During 2022, SNL/NM personnel measured groundwater elevations in 166 wells and collected groundwater samples from 16 monitoring wells and one surface water sample from Coyote Springs. Groundwater samples were analyzed for volatile organic compounds (VOCs), total organic halogens, total phenols, nitrate plus nitrite (NPN), total alkalinity, major anions (chloride, bromide, fluoride, and sulfate), Target Analyte List (TAL) metals plus total uranium (at select wells), mercury, explosive compounds (at select wells), total cyanide, radionuclides by gamma spectroscopy, gross alpha/beta activity, radium-226, and radium-228.

Beryllium was detected above the EPA maximum contaminant level (MCL) of 0.004 milligram per liter (mg/L) in the surface water sample from Coyote Springs at a concentration of 0.00703 mg/L, which is similar to historical concentrations and is considered to be of natural origin. Although the sample was collected from surface water, it was considered representative of groundwater since the spring is discharging groundwater.

Fluoride was detected above the human health standard per New Mexico Water Quality Control Commission Standards for Groundwater of 1.6 mg/L in three monitoring wells at concentrations ranging from 1.68 mg/L to 2.75 mg/L (20.6.2.3103A NMAC). The fluoride results are similar to historical concentrations and are also considered to be of natural origin. Mercury was detected above the EPA MCL of 0.002 mg/L in one filtered sample at a concentration of 0.00201 mg/L. However, mercury was not detected above the EPA MCL in the duplicate analysis for the filtered and unfiltered samples from the same monitoring well.

The water levels measured in the monitoring wells reflect the impact of the groundwater withdrawal by production wells in the northwestern portion of KAFB and in the city.

A.4.5.1.1 Technical Area-V Groundwater Area of Concern

The TA-V Groundwater AOC encompasses about 35 acres at the northeast corner of TA-III. The vadose zone at TA-V extends from ground surface to the water table at a depth of about 500 feet and consists of heterogeneous, lenticular, coarse- to fine-grained deposits. The underlying aquifer at TA-V consists of fine-grained, clay-rich, alluvial fan sediments (SNL 2005). To the west of TA-V, these sediments interfinger with highly permeable sand and gravels (Rinehart and Love 2016).

Groundwater in the vicinity of TA-V flows generally from east to west at a rate of between 0.29–225 feet/year (SNL 2015a). To the west of TA-V, groundwater flow paths turn to the north in response to pumpage from large municipal well fields located north and northwest of KAFB. The sharp change in flow direction coincides with the location of coarse, well-sorted sediments. These sediments are much more permeable than the fine-grained sediments of the alluvial fan lithofacies at TA-V and permit more rapid groundwater flow. Model-estimated time of travel from the area directly south of TA-V to the production wells exceeds 100 years (SNL 2005).

During 2022, groundwater elevations were measured in, and groundwater samples were collected from, 18 monitoring wells (SNL 2023d). The samples were analyzed for VOCs, NPN, alkalinity, major anions (bromide, chloride, fluoride, and sulfate), filtered metals (arsenic, iron, and manganese), TAL metals plus total uranium, radionuclides by gamma spectroscopy, gross alpha/beta activity, and tritium. No analytes were detected at concentrations exceeding the associated EPA MCLs, except for trichloroethylene (TCE) and nitrate. TCE concentrations exceeded the EPA MCL of 5 micrograms per liter ($\mu\text{g/L}$) in samples from six monitoring wells, with a maximum concentration of 12.4 $\mu\text{g/L}$. The analytical results of TCE in the other monitoring wells were below the EPA MCLs and are consistent with historical trends.

Nitrate concentrations exceeded the EPA MCL of 10 mg/L in samples from three monitoring wells with a maximum concentration of 13.5 mg/L. The distribution of nitrate concentrations is laterally widespread in the area, both inside and outside the TA-V boundary, although the extent of the 10-mg/L nitrate concentration has remained relatively stable beneath TA-V. Furthermore, two wells that have shown nitrate concentrations close to and occasionally exceeding the MCL are hydraulically upgradient of the TA-V septic system, indicating that a significant portion of nitrate concentrations in groundwater may be attributable to natural conditions, or to upgradient sites not managed by NNSA and SNL/NM (SNL 2015a).

A.4.5.1.2 Tijeras Arroyo Groundwater Area of Concern

The TAG AOC covers about 1.8 mi² and contains three TAs (TA-I, TA-II, and TA-IV). The TAG AOC is underlain by two water-bearing units: the PGWS and the deeper Regional Aquifer. The PGWS is a thin layer of saturated sediments above a clayey perching horizon. Under the perching horizon is an approximately 200-foot thick sequence of unsaturated sediments overlying the Regional Aquifer. The PGWS and the Regional Aquifer consist of alluvial fan sediments of the Santa Fe Group, which are not laterally continuous and consist mostly of silty sands, clayey layers, and poorly sorted gravels. These two water-bearing units merge under the southeast corner of the TAG AOC (SNL 2018d).

Beneath the TAG AOC, the depth to the PGWS ranges from about 270–320 ft-bgs. Depth to water for the Regional Aquifer ranges from about 410–560 ft-bgs (SNL 2018d). Groundwater flow in the PGWS is primarily to the east and southeast across the TAG AOC at an average velocity of about 24 feet/year. Groundwater flow in the Regional Aquifer is inferred to be primarily to the west and northwest across the TAG AOC at an average rate of about 55 feet/year (SNL 2018e). Based on hydraulic properties, much of the surface-water flow in Tijeras Arroyo could migrate downward and impact the PGWS in about 30 days. In stretches of Tijeras Arroyo

where the PGWS is not present, surface water could possibly reach the Regional Aquifer in about 40–50 days (SNL 2021c).

During 2022, groundwater elevations were measured in 27 monitoring wells, and groundwater samples were collected from 21 monitoring wells. Groundwater samples were analyzed for VOCs, NPN, alkalinity, anions, TAL metals plus total uranium, radionuclides by gamma spectroscopy, gross alpha/beta activity, and tritium. No analytes were detected at concentrations exceeding the associated EPA MCLs, except for nitrate, TCE, and tetrachloroethene (PCE). Nitrate concentrations exceeded the EPA MCL of 10 mg/L in samples from five monitoring wells screened in the PGWS, with a maximum concentration of 22.2 mg/L. An upgradient well, located where the PGWS merges with the Regional Aquifer, had a nitrate concentration of 34.4 mg/L. None of the samples from the Regional Aquifer wells, except where the aquifer merges with the PGWS, exceeded the nitrate EPA MCL; the maximum nitrate concentration was 3.92 mg/L. Recent nitrate concentrations across the monitoring well network are consistent with historical trends. TCE and PCE exceeded the EPA MCL of 5 µg/L in one PGWS monitoring well, with concentrations of 19.7 and 10.4 µg/L, respectively. The TCE and PCE concentrations in this well have been relatively consistent since September 2020. Another PGWS monitoring well had a TCE concentration of 4.55 µg/L. None of the Regional Aquifer monitoring wells had VOC concentrations exceeding EPA MCLs.

A.4.5.1.3 Burn Site Groundwater Area of Concern

The BSG AOC is located in Lurance Canyon, one of three canyons on the eastern edge of the Coyote Canyon Test Area and within the Manzanita Mountains (SNL 2023e). Regionally, groundwater in the western Manzanita Mountains flows generally toward the west from a groundwater flow divide located east of the BSG AOC and predominantly occurs in fractured igneous and metamorphic rocks. Across the BSG AOC, groundwater migrates through bedrock fractures in a generally westward direction, although north-trending brecciated fault zones likely permit migration of groundwater along those zones. The fracture flow system has a low permeability and is poorly interconnected. Some faults and fractures are sealed and act as barriers to groundwater flow. The depth to water ranges from about 46–363 ft-bgs, and due to decreasing water levels, the depth to water has been increasing at a rate of about 3 or more feet per year (SNL 2023f).

Groundwater flow along Lurance Canyon discharges primarily as direct underflow to the unconsolidated basin fill deposits of the Albuquerque Basin. Based on field observations, some discharge also occurs at ephemeral and perennial springs along the mountain front. Much of the flow that discharges from these springs undergoes evapotranspiration. Some flow from springs infiltrates nearby alluvial deposits.

During 2022, groundwater elevations were measured in 17 wells, and groundwater samples were collected from 14 wells. Samples were analyzed for VOCs, explosive compounds, total petroleum hydrocarbons-diesel range organics, total petroleum hydrocarbons-gasoline range organics, NPN, alkalinity, major anions (bromide, chloride, fluoride, and sulfate), TAL metals, radionuclides by gamma spectroscopy, gross alpha/beta activity, isotopic uranium, and tritium (SNL 2023c). No analytes were detected at concentrations exceeding the associated EPA MCLs,

except for nitrate. Nitrate concentrations exceeded the EPA MCL of 10 mg/L in samples from six monitoring wells, with a maximum concentration of 38.1 mg/L observed during the April 2022 sampling event. The nitrate concentration trends have varied within a narrow range over the past year. Since August 1996, the maximum concentration of nitrate detected has been 49.6 mg/L.

A.4.5.1.4 Chemical Waste Landfill

The CWL is a 1.9-acre former disposal site located in the southeastern corner of TA-III undergoing post-closure care. The site was used for the disposal of chemical and solid wastes generated by SNL/NM research activities during 1962–1985 (SNL 2023a). Additionally, a small amount of radioactive waste was disposed of during the operational years. The CWL area was also used as a hazardous waste drum storage facility during 1981–1989. The CWL was operated under interim status until 1985 and was closed under interim status according to the NMED-approved CWL Final Closure Plan (SNL 1992) and in accordance with 20.4.1.600 NMAC. The CWL is a regulated unit under RCRA.

Groundwater monitoring began in 1985 at the CWL as required by 20.4.1.600 NMAC. In 1990, TCE was identified in groundwater at a concentration exceeding the EPA MCL. This finding led to the development and incorporation of a corrective action program into the CWL Final Closure Plan. Groundwater and subsurface soil and soil-vapor investigations, as well as two Voluntary Corrective Measures (VCMs), were subsequently conducted in accordance with the CWL Final Closure Plan. The two VCMs were implemented between 1997 and 2002 and included a soil-vapor extraction VCM to reduce VOC concentrations in soil-vapor and groundwater, and a landfill excavation VCM to remove contaminated soil and debris. Geophysical surveys confirmed the removal of all former disposal areas, and the results of final verification soil samples demonstrated that post-excavation conditions met industrial risk-based standards approved by NMED. The excavation was then backfilled and an at-grade evapotranspirative cover system was constructed over the CWL as an interim measure and later approved as the final remedy. Upon NMED approval of CWL closure (NMED 2011), the CWL PCCP became the enforceable regulatory document.

Compliance groundwater and soil-vapor monitoring systems are sampled to ensure the protection of groundwater quality during the post-closure care period. Required monitoring (groundwater and soil vapor), inspections, and maintenance/repair activities are defined in the PCCP and comprehensively documented in annual post-closure care reports submitted to NMED in March of each year. Monitoring, inspection, and maintenance/repair results continue to confirm the evapotranspirative cover system and monitoring systems are functioning as intended, and site conditions remain protective of human health and the environment.

A.4.5.1.5 Mixed Waste Landfill

The MWL is a 2.6-acre SWMU 76 located in the north-central portion of TA-III that received low-level radioactive, hazardous, and mixed waste from March 1959 through December 1988. The MWL consists of two distinct disposal areas: the classified area and the unclassified area (SNL 2024f). Wastes were disposed of in unlined vertical pits and horizontal trenches.

Corrective action at the MWL was completed under the corrective action provisions of the Compliance Order on Consent (NMED 2004). The nature and extent of contamination were characterized during the Phase I and II RCRA Facility Investigations, as well as a human health risk assessment under an industrial land-use scenario. Contaminants of concern for the MWL include VOCs, metals, and tritium. As part of the corrective action process for the MWL, NMED selected a vegetative soil cover (i.e., evapotranspirative cover) with a biointrusion barrier as the final remedy. The evapotranspirative cover reduces the potential for surface water to enter the former disposal area, thereby minimizing the potential for contaminant migration to groundwater. The approximately 500-foot unsaturated vadose zone also protects the Regional Aquifer beneath the disposal area. The MWL evapotranspirative cover system was completed in 2009 and is detailed in the MWL Corrective Measures Implementation Report (SNL 2010a).

Since 2014, activities at the MWL have been conducted in accordance with the requirements of the MWL LTMMP (SNL 2012b), which was approved by NMED on January 8, 2014 (NMED 2014). The air, surface soil, vadose zone, groundwater, and biota are monitored to ensure that the final remedy and site conditions are protective of human health and the environment. Inspections and maintenance/repair activities are conducted to ensure the integrity and proper function of the evapotranspirative cover system and associated monitoring systems. On March 13, 2016, the second NMED Final Order (NMED 2016) became effective, granting Corrective Action Complete with Controls status to the MWL and incorporating the MWL LTMMP into the RCRA permit (NMED 2016). Required monitoring, inspections, and maintenance/repair activities are comprehensively documented in annual long-term monitoring and maintenance reports submitted to NMED in June of each year. Monitoring inspection and maintenance/repair results continue to confirm that the evapotranspirative cover system and monitoring systems are functioning as intended, and site conditions remains protective of human health and the environment.

A.4.5.2 Groundwater Quantity (Production and Use)

The Regional Aquifer supplies water for KAFB, and KAFB supplies all water for SNL/NM. During 2022, KAFB pumped groundwater from seven water supply wells (KAFB 2022b). The total KAFB production in 2022 was about 784 million gallons. Water demand at SNL/NM has been reduced through water conservation strategies, and groundwater usage has decreased by about 33 percent relative to an FY 2007 baseline (SNL 2023a).

Recharge to the Santa Fe Group aquifer system in the basin occurs along stream channels, arroyos, and mountain fronts, as well as from irrigation, septic fields, sewage systems, and subsurface groundwater inflow at the northern end of the basin (USGS 2019). Outflow from the Santa Fe Group aquifer system in the basin occurs through groundwater pumping, irrigation seepage to lateral drains, riparian evapotranspiration, and subsurface groundwater outflow at the southern end of the basin.

A.4.6 Air Quality

This section provides supplemental information regarding air quality data, impacts, and requirements contained in Chapter 4, Section 4.6 of this SWEIS.

Air emissions sources at SNL/NM are also subject to the following air pollution control standards:

- **New Source Performance Standards (NSPS):** Emissions limits and control requirements for new, modified, or reconstructed sources in multiple industrial categories, including boilers and reciprocating internal combustion engines (RICE) (40 CFR Part 60).
- **National Emissions Standards for Hazardous Air Pollutants (NESHAPs):** Standards that apply to sources emitting HAPs, including boilers, generators, RICE, halogenated solvent cleaning, activities involving asbestos, and DOE facilities that emit radionuclides other than radon (40 CFR Parts 61 and 63).
- **Protection of Stratospheric Ozone:** Standards that apply to the procurement, recycling, and use of substances that deplete stratospheric ozone (40 CFR Part 82).
- **Phasedown of Hydrofluorocarbons (HFCs):** Standards that apply to the procurement, recycling, monitoring, and use of HFCs (40 CFR Part 84).

All radionuclide emissions at SNL/NM are classified as point releases; that is, radionuclides can potentially be released to the atmosphere through an exhaust stack or vent. Tritium and radionuclides could potentially be released from experiments, waste processing, testing, and production operations identified in Table A-17.

Table A-17. Potential Sources of Radionuclides

Source Name	Location	Source Description	Potential Radionuclide Release
Ion Beam Laboratory	TA-I	Ion and electron accelerators used to study and modify materials systems	Tritium
Neutron Generator Facility	TA-I	Production facility for neutron generators	Tritium
Process Research and Development Laboratory	TA-I	Small-scale laboratory operation involved in handling and researching sealed and unsealed tritiated materials	Tritium
Sandia Tomography and Radionuclide Transport (START) Laboratory	TA-I	Lab used to perform small-scale experiments	Trace radionuclides
Explosive Components Facility	TA-II	Facility used to test neutron generator design and manufacturing	Tritium
Radioactive and Mixed Waste Management Unit (RMWMU)	TA-III	Facility used to handle radioactive and mixed waste	Trace radionuclides
High-Energy Radiation Megavolt Electron Source III	TA-IV	Gamma simulator used primarily to simulate the effects on electronics of prompt radiation from a nuclear burst	Nitrogen-13 and oxygen-15
Z Accelerator Facility	TA-IV	Experimental facility used to research light-ion inertial confinement fusion	Trace radionuclides
Annular Core Research Reactor (ACRR)	TA-V	Reactor used to provide neutron and gamma radiation environments for testing weapons components, and reactor safety research	Trace radionuclides

Source Name	Location	Source Description	Potential Radionuclide Release
Auxiliary Hot Cell Unit (AHCU)	TA-V	Facility used to identify, sort, characterize, and repackage legacy nuclear materials	Trace radionuclides

Source: SNL 2021a.

Radionuclide releases by location are provided in Table A-18.

Table A-18. Radionuclide Releases in Curies/Year by Location

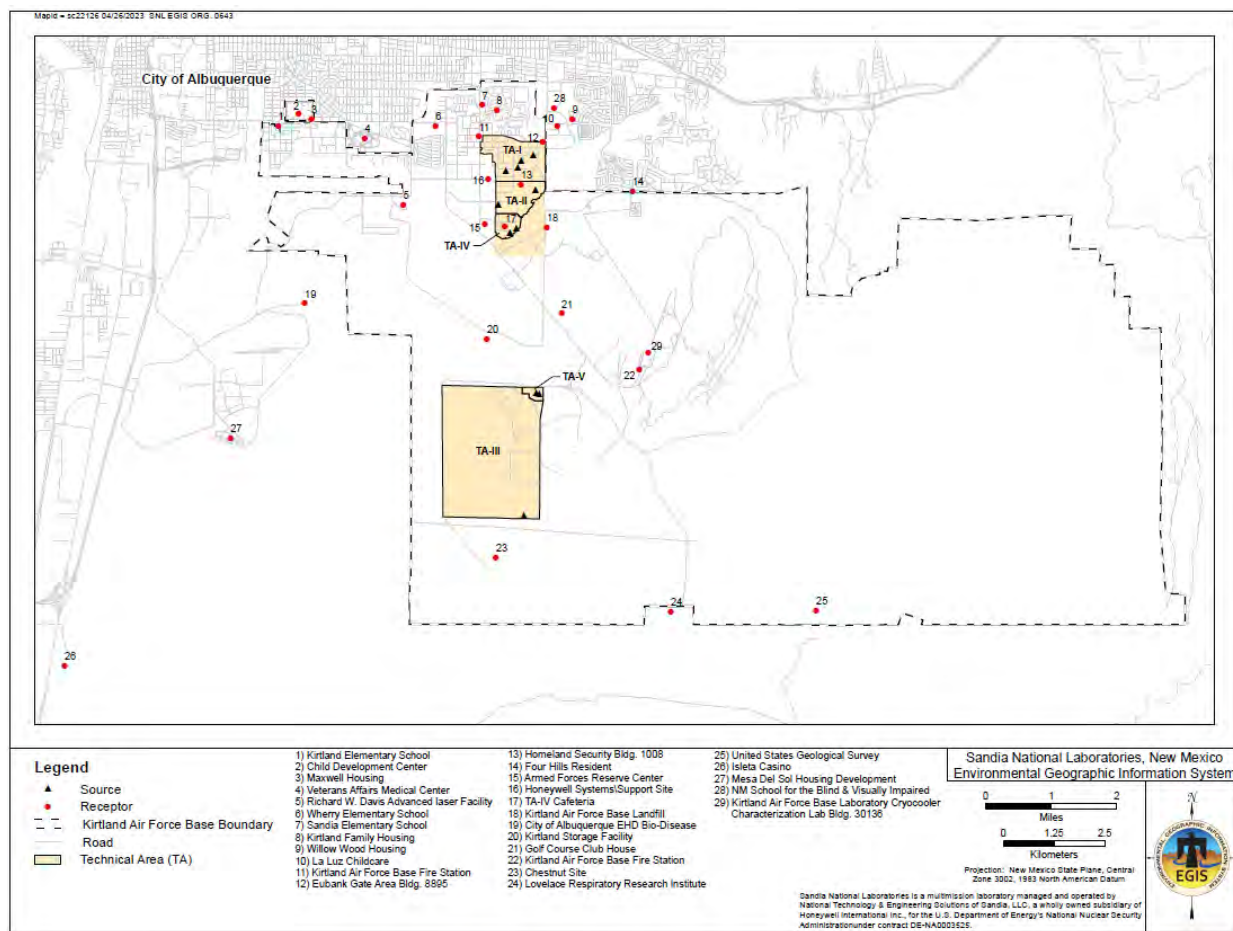
Source Name	Radionuclide Emitted	2018	2019	2020	2021	2022
TA-I: Ion Beam Laboratory	Tritium	38.2	25.2	20.2	16.8	13.3
TA-I: Neutron Generator Facility	Tritium	11.83	18.73	21.84	32.76	15.77
TA-I: Process Research and Development Laboratory	Tritium	1.50×10^{-4a}	8.50×10^{-5}	3.50×10^{-5}	2.00×10^{-5}	—
TA-II: Explosive Components Facility	Tritium	1.07×10^{-3}	2.70×10^{-3}	2.50×10^{-3}	2.61×10^{-3}	3.00×10^{-3}
TA-III: RMWU Unit (1)	Americium-241	—	1.20×10^{-6}	3.11×10^{-9}	3.11×10^{-9}	3.11×10^{-9}
TA-III: RMWU (2)	Cesium-137	5.02×10^{-6}	6.40×10^{-6}	5.02×10^{-6}	5.02×10^{-6}	5.02×10^{-6}
TA-III: RMWU (3)	Plutonium-238	—	5.10×10^{-7}	6.91×10^{-10}	6.91×10^{-10}	6.91×10^{-10}
TA-III: RMWU (4)	Plutonium-239	—	3.20×10^{-6}	2.03×10^{-6}	2.03×10^{-6}	2.03×10^{-6}
TA-III: RMWU (5)	Plutonium-240	—	1.10×10^{-6}	7.50×10^{-9}	7.50×10^{-9}	7.50×10^{-9}
TA-III: RMWU (6)	Plutonium-241	—	6.80×10^{-6}	1.66×10^{-8}	1.66×10^{-8}	1.66×10^{-8}
TA-III: RMWU (7)	Plutonium-242	—	4.30×10^{-10}	4.34×10^{-13}	4.34×10^{-13}	4.34×10^{-13}
TA-III: RMWU (8)	Strontium-90	5.02×10^{-6}	3.90×10^{-6}	5.02×10^{-6}	5.02×10^{-6}	5.02×10^{-6}
TA-III: RMWU (9)	Tritium (elemental)	1.54×10^{-1}	1.05×10^{-3}	5.78×10^{-6}	5.21×10^{-4}	4.57×10^{-6}
TA-III: RMWU (10)	Tritium (oxide)	1.28×10^{-2}	9.34×10^{-4}	1.29×10^{-5}	4.80×10^{-4}	7.34×10^{-6}
TA-III: RMWU (11)	Tritium (particulate)	—	1.40×10^{-5}	1.10×10^{-3}	1.10×10^{-3}	1.10×10^{-3}
TA-III: RMWU (12)	Uranium-234	—	5.10×10^{-7}	1.18×10^{-6}	1.18×10^{-6}	3.70×10^{-7}
TA-III: RMWU (13)	Uranium-235	—	1.90×10^{-8}	4.64×10^{-8}	4.64×10^{-8}	4.60×10^{-8}
TA-III: RMWU (14)	Uranium-238	—	6.80×10^{-8}	3.70×10^{-7}	3.70×10^{-7}	1.18×10^{-6}
TA-IV: High-Energy Radiation Megavolt Electron Source III (1)	Nitrogen-13	7.40×10^{-4}	7.40×10^{-4}	5.98×10^{-4}	6.60×10^{-4}	7.33×10^{-4}
TA-IV: High-Energy Radiation Megavolt Electron Source III (2)	Oxygen-15	7.40×10^{-5}	7.40×10^{-5}	6.00×10^{-5}	6.60×10^{-5}	7.30×10^{-5}
TA-IV: Z Accelerator Facility	Tritium	2.50×10^{-3}	1.60×10^{-3}	1.80×10^{-3}	1.05×10^{-3}	1.50×10^{-3}
TA-V: ACRR	Argon-41	1.57	—	0.79	0.89	1.79
TA-V: AHCU (1)	Americium-241	—	2.00×10^{-8}	7.00×10^{-11}	7.00×10^{-11}	7.00×10^{-11}
TA-V: AHCU (2)	Cesium-137	1.00×10^{-8}	1.50×10^{-8}	1.00×10^{-8}	1.00×10^{-8}	1.00×10^{-8}
TA-V: AHCU (3)	Krypton-85	2.00×10^{-8}	1.00×10^{-8}	2.00×10^{-8}	2.00×10^{-8}	2.00×10^{-8}
TA-V: AHCU (4)	Plutonium-238	—	1.30×10^{-9}	2.80×10^{-11}	2.80×10^{-11}	2.80×10^{-11}
TA-V: AHCU (5)	Plutonium-239	—	2.80×10^{-10}	2.60×10^{-11}	2.60×10^{-11}	2.60×10^{-11}
TA-V: AHCU (6)	Plutonium-241	—	2.10×10^{-10}	2.10×10^{-10}	2.10×10^{-10}	2.10×10^{-10}
TA-V: AHCU (7)	Samarium-151	—	7.00×10^{-11}	2.80×10^{-10}	2.80×10^{-10}	2.80×10^{-10}
TA-V: AHCU (8)	Strontium-90	1.50×10^{-8}	2.80×10^{-11}	1.50×10^{-8}	1.50×10^{-8}	1.50×10^{-8}

Source Name	Radionuclide Emitted	2018	2019	2020	2021	2022
TA-V: AHCU (9)	Tritium	—	2.60×10^{-11}	1.30×10^{-9}	1.30×10^{-9}	1.30×10^{-9}
TA-V: AHCU (10)	Uranium-235	—	2.60×10^{-11}	2.60×10^{-11}	2.60×10^{-11}	—
Total:		51.77	43.94	42.84	50.46	30.87

a. Scientific notation is used to simplify the presentation; as a clarifying example, 1.5×10^{-4} Ci is the same as 0.00015 Ci.

Source: SNL 2019; SNL 2020b; SNL 2021a; SNL 2022g; and SNL 2023a.

The location of vents and receptors associated with the radionuclide release and modeling are provided in Figure A-23.



Source: SNL 2021d.

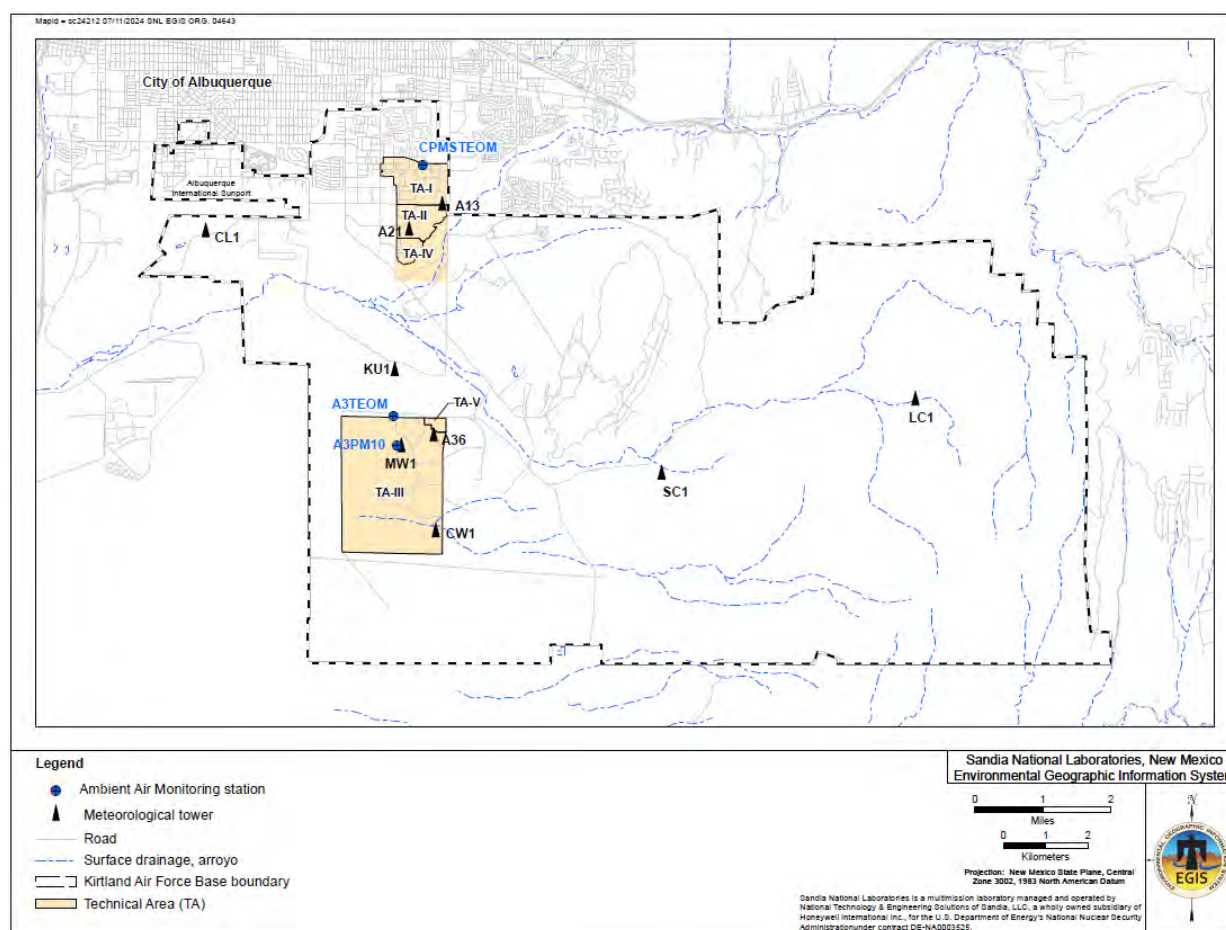
Figure A-23. Vents for Potential Sources of Radionuclides and Receptors

SNL/NM also conducts meteorological monitoring onsite via a network of nine towers. Table A-19 provides the name and parameters monitored for each tower; Figure A-24 shows the tower locations.

Table A-19. Onsite Meteorological Monitoring Towers

Tower	Height	Barometric Pressure	Rainfall	Relative Humidity	Temperature	Wind Velocity
A13	30 meters	—	—	Yes	Yes	Yes
A21	10 meters	Yes	Yes	Yes	Yes	Yes
A36	60 meters	Yes	Yes	Yes	Yes	Yes
CL1	10 meters	—	—	Yes	Yes	Yes
CW1	10 meters	—	—	Yes	Yes	Yes
KU1	10 meters	—	—	Yes	Yes	Yes
LC1	10 meters	Yes	Yes	Yes	Yes	Yes
MW1	10 meters	—	—	Yes	Yes	Yes
SC1	10 meters	—	Yes	Yes	Yes	Yes

Source: SNL 2023a.

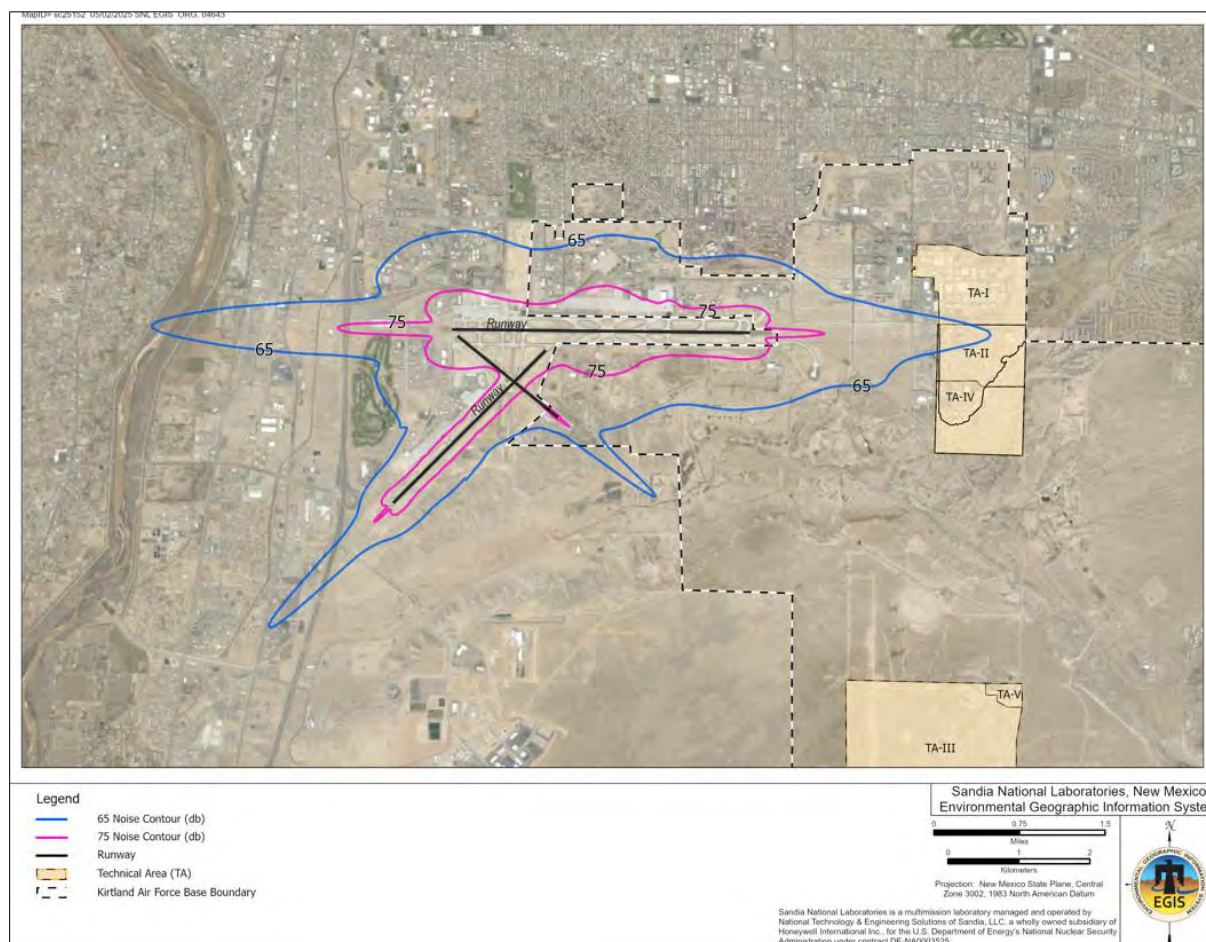


Source: SNL 2022g.

Figure A-24. Ambient Air Monitoring Locations

A.4.7 Noise

This section provides supplemental information regarding noise contained in Chapter 4, Section 4.7 of this SWEIS. Noise contours for 65 dB and 75 dB from aircraft operations conducted at KAFB/Sunport are provided in Figure A-25.



Source: SNL 2022g.

Figure A-25. The Sunport Noise Contours

A.4.8 Biological Resources

This section provides supplemental information to Chapter 4, Section 4.8, of this SWEIS.

A.4.8.1 Vegetation Classification

Grasslands

The following types of grasslands are found at SNL/NM:

Short Grasslands: Include short grasses less than or equal to 20 inches in height.

Dwarf Shrub Grasslands: Include grasslands that have a low-growing (generally less than 20 inches tall) shrub component that forms 25 percent or more of the total vegetative cover. Grasses are moderate in height. Common plants associated with this vegetation cover include New Mexico needle and thread (*Stipa neomexicana*), ring muhly (*Muhlenbergia torreyi*), black grama (*Bouteloua eriopoda*), six-weeks grama (*Bouteloua barbata*), and winterfat (*Krascheninnikovia lanata*).

Grasslands with Sparse Dwarf Shrubs: Consist of grasses of moderate height that dominate these grasslands, with dwarf shrubs forming less than 25 percent of cover. Common plants associated with this vegetation cover include black grama, spike dropseed (*Sporobolus contractus*), silverscale saltbush (*Atriplex argentea*), broom snakeweed (*Gutierrezia sarothrae*), and Russian thistle (*Salsola tragus*).

Large Shrub Grassland: Consists primarily of shrubs greater than 20 inches in height. Common plants associated with this vegetation cover include four-wing saltbush (*Atriplex canescens*), galleta (*Pleuraphis jamesii*), Indian ricegrass (*Achnatherum hymenoides*), and spike dropseed.

Woodlands

The following types of woodlands are found at SNL/NM:

Pinyon-Juniper Savanna or Shrub/Woodland/Grassland: Habitat type with open stand structure; low-to-moderate density of trees; minimal shrub cover; and a dense, near-continuous understory of herbaceous plants, mainly grasses with some forbs. Pinyon-juniper savannas are most often found in gentle upland and transitional valleys, including basins and foothills, with monsoon rains during the summer growing season.

Pinyon-Juniper Shrubland or Open Canopy Woodland: Habitat type characterized by variable tree densities (with about 25–60 percent cover), well-developed shrub mid-story, and variable understory cover of grasses and forbs. Junipers are the dominant tree species, intermixed with pines. Precipitation is winter dominated, which can mean less moisture for trees, and favorable conditions for shrub growth, especially in the absence of fire (SNL 2018g).

Pinyon-Juniper Persistent Woodland or Closed Canopy Woodland: Habitat type usually characterized by dense, closed canopy structure, with limited mid-story and understory. Pine tends to be more dominant than junipers, with about 60–100 percent cover and overlapping crowns. This habitat type is found on a variety of substrates and terrains, but most commonly on rugged uplands with shallow rocky soils. Topographic features can create barriers to fire, and precipitation is generally bimodal, with small peaks of rain in summer and winter (SNL 2020c).

Riparian Vegetation

Arroyo: The most common riparian habitat type within SNL/NM. Junipers, a variety of shrubs, and some bunch grasses dominate this habitat type. Riparian woodland vegetation is primarily limited to the upper reach of Arroyo del Coyote and the canyon drainages that feed into it. Dense

stands of trees grow where there is a sufficient supply of subsurface water, such as at G Spring and near Coyote Springs. Large individuals of Fremont cottonwood (*Populus fremontii*) occur in these areas, representing one of the few native tree species on SNL/NM specific to riparian habitat. Most trees along the arroyos are introduced species that have escaped cultivation. Salt cedar (*Tamarix chinensis*), an introduced species that is a nuisance in many drainages in the western United States, appears along many of the arroyos onsite and forms dense stands on Arroyo del Coyote at G Spring and near Coyote Springs. Two other exotic trees, Siberian elm (*Ulmus pumila*) and tree-of-heaven (*Ailanthus altissima*), have also become established locally (SNL 2012c). Common plants associated with this vegetation cover include four-wing saltbush, rubber rabbitbrush (*Ericameria nauseosa*), Apache plume (*Fallugia paradoxa*), and alkali sacaton (*Sporobolus airoides*).

Riparian Canyon Bottoms: Habitat composed of trees and shrubs, occurring in the foothills through the upper reaches of the Manzanita Mountains. The riparian vegetation in the canyons is a more complex mixture of woody species than that of the arroyos on the alluvial surfaces to the west. Although the scrubland arroyo vegetation extends well into the lower parts of the canyons, particularly the Lurance and Madera Canyons, the vegetation becomes more of a true riparian woodland in the upper reaches. A wider diversity of shrubs occurs in the canyons than in the lower arroyos, including one-seed juniper (*Juniperus monosperma*), mountain mahogany (*Cercocarpus montanus*), New Mexico olive (*Forestiera neomexicana*), pinyon pine (*Pinus edulis*), and ponderosa pine (*Pinus ponderosa*).

Wetlands: Natural, spring-fed wetlands are a vegetation cover type that is extremely small in size. Wetlands contain plant species unique to aquatic habitat, with common plants including three-square (*Schoenoplectus americanus*), wire rush (*Juncus balticus*), yerba mansa (*Anemopsis californica*), Torrey's rush (*Juncus torreyi*), cattail (*Typha latifolia*), and rabbitfoot grass (*Polypogon monspeliensis*) (KAFB 2023). Wetlands occur on KAFB and are discussed in more detail in Chapter 4, Section 4.8.4, of this SWEIS.

A.4.8.2 Vegetation Classifications in Developed Areas

Technical Area I

TA-I is a developed, urban work area primarily consisting of paved surfaces where no natural, native vegetation occurs. The landscaped areas include ornamental trees, shrubs, perennials, bunch grasses, and a limited amount of turf or xeric grass near buildings and walkways. The eastern edge and southeastern corner are vegetated with non-landscaped grasses and shrubs (SNL 2017a).

Technical Area II

The vegetation classification for TA-II is a largely disturbed habitat and urban area. During the past few years, some of the work areas and buildings in the central part of TA-II have been removed, and the area has slowly undergone a natural succession to native grassland.

In recent years, new buildings and associated parking areas have been constructed on the west and north sides on the outer perimeter of TA-II. Newly constructed areas are primarily composed of impermeable surfaces and have limited landscaped trees, shrubs, perennials, bunch grasses, and xeric grass near buildings and walkways.

The habitat between the historical and new work areas primarily comprises grasslands of lower to moderate quality that have been affected by the general demolition and construction activities over the past decade (SNL 2017a).

Technical Area III

The primary types of vegetation in TA-III include the following:

- Dwarf Shrub Grassland consists of low-growing (generally less than 0.5 meter tall) shrubs that make up 25 percent or more of the total vegetative cover.
- Large Shrub Grassland areas are dominated by shrubs greater than 0.5 meter in height.
- Grasslands with Sparse Dwarf Shrubs primarily consist of grasses of moderate height with dwarf shrubs forming less than 25 percent cover.

Technical Area IV

TA-IV primarily consists of landscaped areas with ornamental trees, shrubs, perennials, bunch grasses, and a limited amount of turf or xeric grass areas. Native vegetation grows south and east of TA-IV and exterior to the fence but within the DOE fee-owned area (SNL 2017a).

Technical Area V

In TA-V, the vegetation classification has been deemed as urban/landscaped. The TA-V area is mostly covered with impermeable surfaces, including buildings and paved areas. Little landscaping is present in TA-V. The area has no naturally occurring native vegetation; some small, unpaved areas contain only weed species (SNL 2017a).

KAFB-East

This section describes the primary vegetation types within KAFB-East. Closed Canopy Woodland is composed of evergreen trees with crowns that overlap to form a canopy, generally comprising a 60- to 100-percent cover, with low abundance of understory plants. Common plants include the following:

- pinyon pine (*Pinus edulis*),
- one-seed juniper (*Juniperus monosperma*),
- cliff fendlerbush (*Fendlera rupicola*), and
- mountain mahogany (*Cercocarpus montanus*).

Open Canopy Woodland is composed of evergreen trees with crowns that do not usually touch, generally forming a 25- to 60-percent cover, with understory plants ranging in abundance from low to moderate. Common plants include the following:

- one-seed juniper (*Juniperus monosperma*),
- mountain mahogany (*Cercocarpus montanus*),
- Mormon tea (*Ephedra trifurca*), and
- little awn needlegrass (*Achnatherum lobatum*).

Shrub, Woodland, Grassland habitat is composed of shrubs that are generally greater than 0.5 meter tall, with individuals or clumps that do not touch as well as those that do overlap; tree cover is generally less than 25 percent; and understory grasses range from moderate to high abundance. Common plants include the following:

- one-seed juniper (*Juniperus monosperma*),
- four-wing saltbush (*Atriplex canescens*),
- black grama grass (*Bouteloua eriopoda*), and
- blue grama grass (*Bouteloua gracilis*).

SNL/NM and KAFB woodlands provide necessary habitat to support many species of birds, reptiles, amphibians, and mammals that rely on good quality and relatively undisturbed habitats (SNL 2017a).

KAFB-West

The primary types of vegetation in KAFB-West include the following:

- Dwarf Shrub Grassland consists of low-growing (generally less than 0.5 meter tall) shrubs that comprise 25 percent or more of the total vegetative cover.
- Large Shrub Grassland areas are dominated by shrubs greater than 0.5 meter in height.
- Grasslands with Sparse Dwarf Shrubs primarily consist of grasses of moderate height with dwarf shrubs forming less than 25 percent cover.

Eubank Corridor

The Eubank Corridor vegetation classification has been deemed as urban/landscaped and Grassland with Sparse Dwarf-Shrub Layer (SNL 2017a).

The ASERs (SNL 2017b; 2018g; 2019; 2020b; 2021a; 2022g; 2023e) and the Grassland Management Plan (SNL 2018g) provide extensive information on terrestrial vegetation, including grassland habitat (SNL 2017a and SNL 2020c).

A.4.8.3 Wildlife Species Observed on SNL/NM

A variety of wildlife surveys have been done at several SNL/NM locations over the past few years, including herpetofaunal (reptiles and amphibians), bats, avian (birds), and mammalian surveys. Ecology survey locations are presented in Figure A-26 and described in Table A-20. Table A-21 lists wildlife species observed on SNL/NM.

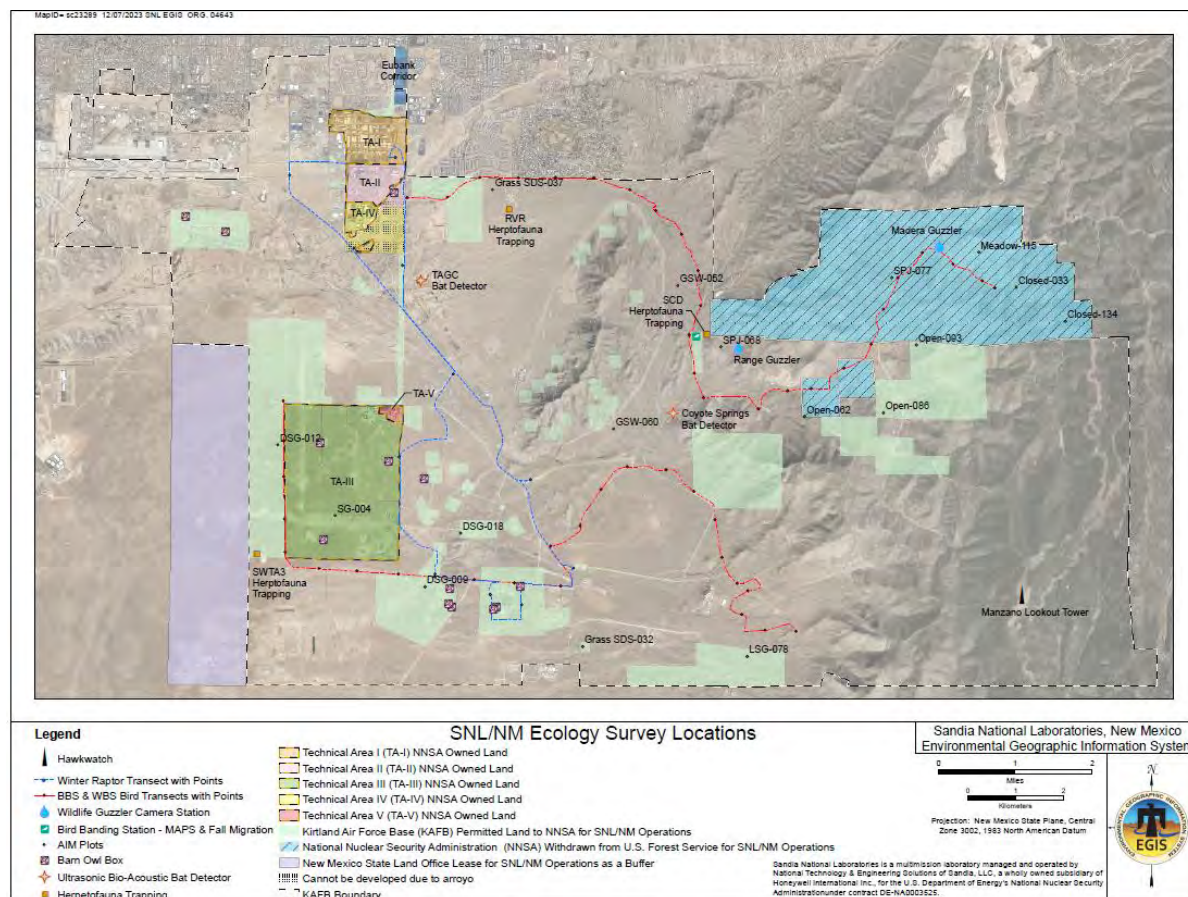


Figure A-26. Ecology Survey Locations

Table A-20. Wildlife Surveys

Site Name	Vegetation Type	Survey Type
Robotic Vehicle Range	Grassland with Sparse Dwarf Shrub	herpetofaunal surveys, bird surveys
Old Scale Compatibility Dome	Shrub, Open Woodland, Grassland	herpetofaunal surveys, bird banding
Tijeras Arroyo Golf Course	Urban Area, Ornamental Landscaping	bird surveys, bat surveys
West and Southwest of TA-III	Large Shrub Grassland	herpetofaunal surveys, bird surveys
Coyote Springs	Wetland	bat surveys

Site Name	Vegetation Type	Survey Type
Madera Canyon Guzzler	Open Woodland, Shrub, Grassland	camera trap – mammals and other
Range Wildlife Guzzler	Open Woodland, Shrub, Grassland	bird surveys, camera trap – mammals and other

Source: SNL 2018f; SNL 2019; SNL 2020b; SNL 2021a; SNL 2022g; and SNL 2023a.

Contaminant sampling has not been completed in wildlife species since 2001 because no significantly elevated levels of metals or radionuclides have been observed in soil or vegetation samples (SNL 2006; SNL 2007; SNL 2008; SNL 2009; SNL 2010b; SNL 2011b; SNL 2012a; SNL 2013; SNL 2014; SNL 2015d; SNL 2016a; SNL 2017b; SNL 2018f; SNL 2019; SNL 2020b; SNL 2021a; SNL 2022g; and SNL 2023a).

Table A-21. Wildlife Species Observed on SNL/NM ^a

Common Name	Scientific Name	Classification	Habitat Type	Common Known Location(s) within SNL/NM
American Bullfrog	<i>Lithobates catesbeianus</i>	Reptiles and Amphibians	Wetlands	
Barred tiger salamander	<i>Ambystoma mavortium mavortium</i>	Reptiles and Amphibians	Wetlands, grasslands, woodlands	CSW
Black-tailed rattlesnake	<i>Crotalus molossus</i>	Reptiles and Amphibians	Desert grasslands	
Chihuahuan hook-nosed snake	<i>Gyalopion canum</i>	Reptiles and Amphibians	Riparian, grasslands, scrub	SW Area
Chihuahuan spotted whiptail	<i>Aspidoscelis exsanguis</i>	Reptiles and Amphibians	Grasslands	KAFB-East, SCD
Coachwhip	<i>Masticophis flagellum testaceus</i>	Reptiles and Amphibians	Grasslands	RVR, WTA3, SW Area
Common lesser earless lizard	<i>Holbrookia maculata</i>	Reptiles and Amphibians	Grasslands	WTA3, RVR
Common side-blotched lizard	<i>Uta stansburiana</i>	Reptiles and Amphibians	Grasslands, sandy washes	TA-III, KAFB-West, RVR, WTA3
Couch's spadefoot toad	<i>Scaphiopus couchii</i>	Reptiles and Amphibians	Grasslands, desert	TA-III, WTA3
Desert grassland whiptail	<i>Aspidoscelis uniparens</i>	Reptiles and Amphibians	Grasslands	
Desert massasauga	<i>Sistrurus tergeminus edwardsii</i>	Reptiles and Amphibians	Desert grasslands	WTA3, KAFB-West, Withdrawn Area, SW area
Desert striped whipsnake	<i>Masticophis taeniatus</i>	Reptiles and Amphibians	Grasslands, woodlands	SW Area
Eastern Collared lizard	<i>Crotaphytus collaris</i>	Reptiles and Amphibians	Grasslands	KAFB-East, SCD, WTA3
Glossy snake	<i>Arizona elegans</i>	Reptiles and Amphibians	Grasslands, sagebrush, woodlands	SW Area
Great Plains skink	<i>Plestiodon obsoletus</i>	Reptiles and Amphibians	Grasslands	KAFB-East, RVR, WTA3

Common Name	Scientific Name	Classification	Habitat Type	Common Known Location(s) within SNL/NM
Greater short-horned lizard	<i>Phrynosoma hernandesi</i>	Reptiles and Amphibians	Grasslands	RVR, WTA3
Little striped whiptail	<i>Aspidoscelis inornata</i>	Reptiles and Amphibians	Grasslands	TA-II, TA-III, TA-IV, KAFB-West, RVR, SCD, WTA3
Longnose leopard lizard	<i>Gambelia wislizenii</i>	Reptiles and Amphibians	Grasslands	
Mountain patchnose snake	<i>Salvadora grahamiae</i>	Reptiles and Amphibians	Desert mountains	RVR
New Mexico spadefoot toad	<i>Spea multiplicata</i>	Reptiles and Amphibians	Grasslands, woodlands	TA-III, RVR, WTA3, SCD
New Mexico whiptail	<i>Aspidoscelis neomexicanus</i>	Reptiles and Amphibians	Grasslands	TA-I, TA-II, TA-V, Eubank Corridor, RVR, WTA3
Night snake	<i>Hypsiglena torquata jani</i>	Reptiles and Amphibians	Grasslands, woodlands, mountains	
Plains black-headed snake	<i>Tantilla nigriceps</i>	Reptiles and Amphibians	Grasslands	SW Area
Plains hog-nosed snake	<i>Heterodon nasicus</i>	Reptiles and Amphibians	Riparian, grasslands	RG
Plains spadefoot toad	<i>Spea bombifrons</i>	Reptiles and Amphibians	Grasslands	
Plateau striped whiptail	<i>Aspidoscelis velox</i>	Reptiles and Amphibians	Grasslands	
Prairie rattlesnake	<i>Crotalus viridis</i>	Reptiles and Amphibians	Desert grasslands	TA-II, TA-III, TA-IV, TA-V, KAFB-West, RVR, WTA3, SW Area
Red-spotted toad	<i>Anaxyrus punctatus</i>	Reptiles and Amphibians	Riparian, arroyos	KAFB-West, CSW
Ring-necked snake	<i>Diadophis punctatus</i>	Reptiles and Amphibians	Woodlands	SCD
Roundtail horned lizard	<i>Phrynosoma modestum</i>	Reptiles and Amphibians	Grasslands	
Sonoran gopher snake	<i>Pituophis catenifer affinis</i>	Reptiles and Amphibians	Grassland with sparse dwarf-shrub layer and altered	TA-II, TA-IV, TA-V, Eubank Corridor, RVR, WTA3, RG, SW Area
Southwestern fence lizard	<i>Sceloporus cowlesi</i>	Reptiles and Amphibians	Desert grasslands	TA-V, RVR, WTA3
Terrestrial garter snake	<i>Thamnophis elegans</i>	Reptiles and Amphibians	Riparian, woodlands	TAGC
Tree lizard	<i>Urosaurus ornatus</i>	Reptiles and Amphibians	Grasslands, sandy washes	
Western box turtle	<i>Terapene ornate</i>	Reptiles and Amphibians	Grasslands	
Western diamondback rattlesnake	<i>Crotalus atrox</i>	Reptiles and Amphibians	Desert grasslands	KAFB-East, SCD, Withdrawn Area
Western long-nosed snake	<i>Rhinocheilus lectonei</i>	Reptiles and Amphibians	Grasslands	WTA3, SCD, SW Area

Common Name	Scientific Name	Classification	Habitat Type	Common Known Location(s) within SNL/NM
Woodhouse's toad	<i>Anaxyrus woodhousii</i>	Reptiles and Amphibians	Wetlands, riparian, woodlands, canyons, altered	CSW
Acorn woodpecker	<i>Melanerpes formicivorus</i>	Birds	Riparian, open woodlands	CSW
American coot	<i>Fulica americana</i>	Birds	Wetlands	-
American crow	<i>Corvus brachyrhynchos</i>	Birds	All	All
American goldfinch	<i>Spinus tristis</i>	Birds	Riparian, woodlands	CSW
American goshawk	<i>Accipiter gentilis</i>	Birds	P-J woodlands	Withdrawn Area
American kestrel	<i>Falco sparverius</i>	Birds	Grasslands, woodlands, wetlands	TA-II, TA-III, KAFB-East, KAFB-West, RVR, Assoc. with prairie dogs, CSW, SCD, ST, TIJ
American pipit	<i>Anthus rubescens</i>	Birds	Grasslands, scrub	-
American robin	<i>Turdus migratorius</i>	Birds	Altered, Riparian, woodlands	TAs, CSW, SCD, MCG, MC, OR
American tree sparrow*	<i>Spizelloides arborea</i>	Birds	Woodlands, shrubs	-
American wigeon	<i>Mareca americana</i>	Birds	Wetlands	-
Ash-throated flycatcher	<i>Myiarchus cinerascens</i>	Birds	P-J woodlands, wetlands	CSW, SCD, RG, RVR, OR, WS
Bald eagle	<i>Haliaeetus leucocephalus</i>	Birds	Grasslands, canyondlands	Withdrawn Area
Baltimore oriole	<i>Icterus galbula</i>	Birds	Woodlands, riparian	CSW
Barn owl	<i>Tyto alba</i>	Birds	Altered, grasslands	Nest box locations various
Barn swallow	<i>Hirundo rustica</i>	Birds	Altered, wetlands	TAs, CSW, SCD, RVR
Bell's vireo	<i>Vireo bellii</i>	Birds	Shrubs, wetlands	
Belted kingfisher	<i>Megaceryle alcyon</i>	Birds	Wetlands	CSW
Bewick's wren	<i>Thyromanes bewickii</i>	Birds	Open woodlands, scrub, riparian	KAFB-East, CSW, MC
Black phoebe	<i>Sayornis nigricans</i>	Birds	Wetlands	CSW
Black-chinned hummingbird	<i>Archilochus alexandri</i>	Birds	Riparian, grasslands/shrublands	CSW, RVR, TIJ
Black-chinned sparrow*	<i>Spizella atrogularis</i>	Birds	Scrub, rocky hillsides	CSW, SCD
Black-headed grosbeak	<i>Pheucticus melanocephalus</i>	Birds	P-J woodlands, riparian	CSW, SCD, MCG, MC, WS
Black-throated gray warbler* ^{NM}	<i>Setophaga nigrescens</i>	Birds	P-J woodlands, riparian	Withdrawn Area, CSW, SCD, MC
Black-throated sparrow	<i>Amphispiza bilineata</i>	Birds	Grasslands, riparian	Grasslands, CSW, SCD, OR, WS, MC
Blue gray gnatcatcher	<i>Poliophtila caerulea</i>	Birds	Riparian, woodlands	CSW, SCD, WS, MC

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Blue grosbeak	<i>Passerina caerulea</i>	Birds	Woodlands, riparian	CSW, SCD, TIJ
Blue-winged teal	<i>Spatula discors</i>	Birds	Wetlands	CSW
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	Birds	Woodlands, riparian	CSW
Brewer's sparrow* ^{NM}	<i>Spizella breweri</i>	Birds	Riparian	CSW, SCD
Broad-tailed hummingbird* ^{NM}	<i>Selasphorus platycercus</i>	Birds	Riparian, grasslands/shrublands	CSW, MC
Brown creeper	<i>Certhia americana</i>	Birds	Riparian, woodlands	CSW, MC
Brown thrasher	<i>Toxostoma rufum</i>	Birds	P-J woodlands	MCG
Brown-headed cowbird	<i>Molothrus ater</i>	Birds	Woodlands, riparian	CSW, SCD, MCG, OR
Bufflehead	<i>Bucephala albeolus</i>	Birds	Wetlands	TAGC
Bullock's oriole	<i>Icterus bullockii</i>	Birds	Woodlands, riparian	CSW, SCD
Bushtit* ^{NM}	<i>Psaltiriparus minimus</i>	Birds	P-J woodlands, wetlands	CSW, SCD, WS, MC
Cackling goose	<i>Branta hutchinsii</i>	Birds	Wetlands	-
Cactus wren* ^{NM}	<i>Campylorhynchus brunneicapillus</i>	Birds	Riparian, scrub	CSW, OR
Calliope hummingbird	<i>Selasphorus calliope</i>	Birds	Riparian, open woodlands	CSW, SCD
Canada goose	<i>Branta canadensis</i>	Birds	Wetlands	-
Canyon towhee* ^{NM}	<i>Melospiza fusca</i>	Birds	Woodlands, riparian	CTF-East, CSW, SCD, MCG, MC, OR, WS
Canyon wren	<i>Catherpes mexicanus</i>	Birds	Mountainous open woodlands	MC
Cassin's finch*	<i>Haemorhous cassinii</i>	Birds	Riparian, pine woodlands	CSW, SCD, Withdrawn Area, RG
Cassin's kingbird	<i>Tyrannus vociferans</i>	Birds	Open P-J woodlands, wetlands, riparian	CSW, SCD, TIJ
Cassin's sparrow* ^{NM}	<i>Peucaea cassinii</i>	Birds	Grasslands, riparian	TA-III, WTA3, ST, TIJ, OR, KAFB-West, KAFB-East, CSW
Cassin's vireo	<i>Vireo cassinii</i>	Birds	Woodlands	SCW, SCD
Cedar waxwing	<i>Bombycilla cedrorum</i>	Birds	Riparian, woodlands	CSW
Chestnut-collared longspur	<i>Calcarius ornatus</i>	Birds	Grasslands	TA-III, WTA3, RVR, TIJ
Chihuahuan meadowlark	<i>Sturnella lilianae</i>	Birds	Grasslands, riparian	TA-I, TA-II, TA-III, WTA3, ST, RVR, TA-IV, KAFB-East, Assoc. with prairie dogs, CSW, SCD
Chihuahuan raven	<i>Corvus cryptoleucus</i>	Birds	Grasslands, woodlands, wetlands	CSW, others

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Chipping sparrow	<i>Spizella passerina</i>	Birds	Ponderosa woodlands, riparian	Withdrawn Area, CSW, SCD
Cinnamon teal	<i>Spatula cyanoptera</i>	Birds	Wetlands	-
Clark's nutcracker* ^{NM}	<i>Nucifraga columbiana</i>	Birds	Open woodlands	MCG
Clay-colored sparrow	<i>Spizella pallida</i>	Birds	Shrublands, grassland	-
Cliff swallow	<i>Petrochelidon pyrrhonota</i>	Birds	Wetlands	CSW, RVR, TIJ
Common black hawk	<i>Buteogallus anthracinus</i>	Birds	Riparian forests in canyons and deserts	Withdrawn Area
Common grackle	<i>Quiscalus quiscula</i>	Birds	Woodlands, riparian, grasslands	CSW, TAGC
Common merganser	<i>Mergus merganser</i>	Birds	Wetlands	CSW
Common nighthawk*	<i>Chordeiles minor</i>	Birds	Riparian, grasslands, Ponderosa pine	CSW, RG, Withdrawn Area
Common poorwill	<i>Phalaenoptilus nuttalli</i>	Birds	Riparian, grasslands/shrublands	CSW, SCD
Common raven	<i>Corvus corax</i>	Birds	Grasslands, woodlands, wetlands	CSW, MCG, RG, TIJ, others
Common yellowthroat	<i>Geothlypis trichas</i>	Birds	Woodlands, riparian, shrub	CSW, TAGC
Cooper's hawk	<i>Accipiter cooperii</i>	Birds	Woodlands	KAFB-East, CSW, SCD, MCG, RG, TIJ
Cordilleran flycatcher	<i>Empidonax occidentalis</i>	Birds	Woodlands, riparian	-
Crissal thrasher*	<i>Toxostoma crissale</i>	Birds	P-J woodlands, riparian	Withdrawn Area, CSW, SCD, MCG, TIJ
Curve-billed thrasher	<i>Toxostoma curvirostre</i>	Birds	Desert grasslands, riparian	CSW, SCD, MCG, RVR
Dark-eyed junco	<i>Junco hyemalis</i>	Birds	Scrub, riparian	CSW, SCD, MCG, MC, TIJ, OR, WS
Dickcissel	<i>Spiza Americana</i>	Birds	Riparian, scrub	CSW
Downy woodpecker	<i>Dryobates pubescens</i>	Birds	Woodlands	-
Dusky flycatcher	<i>Empidonax oberholseri</i>	Birds	Ponderosa woodlands, wetlands, riparian	Withdrawn Area, CSW, SCD
Eurasian collared dove	<i>Streptopelia decaocto</i>	Birds	Altered	MCG, MC, SCD, CSW
European starling	<i>Sturnus vulgaris</i>	Birds	Altered	TAs, RG
Evening grosbeak*	<i>Coccothraustes vespertinus</i>	Birds	Riparian, woodlands	CSW, OR, MCG
Ferruginous hawk	<i>Buteo regalis</i>	Birds	Grasslands, P-J woodlands	CSW
Flammulated owl*	<i>Otus flammeolus</i>	Birds	Ponderosa pine, mature woodlands, riparian	CSW
Fox sparrow	<i>Passerella iliaca</i>	Birds	Scrub, riparian	CSW

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Gadwall	<i>Mareca strepera</i>	Birds	Wetlands	-
Golden eagle	<i>Aquila chrysaetos</i>	Birds	Grasslands	KAFB-East, CSW, RG, Assoc. with prairie dogs
Grace's warbler*	<i>Setophaga graciaea</i>	Birds	Ponderosa woodlands	Withdrawn Area, CSW, SCD
Gray catbird	<i>Dumetella carolinensis</i>	Birds	Altered, scrub, riparian	SCD, CSW
Gray flycatcher	<i>Empidonax wrightii</i>	Birds	Wetlands, riparian	CSW, SCD, WS, MC
Gray vireo*	<i>Vireo vicinior</i>	Birds	P-J woodlands/grasslands, wetlands	KAFB-East, KAFB-West, Withdrawn Area, CSW, SCD, OR, WS
Great blue heron	<i>Ardea Herodias</i>	Birds	Wetlands, riparian, grasslands	killed at pole near TAGC
Great horned owl	<i>Bubo virginianus</i>	Birds	Grasslands, woodlands	TA-III MCG, RG
Greater roadrunner	<i>Geococcyx californica</i>	Birds	Desert grasslands	TA-V, CSW, RG, TIJ
Greater yellowlegs	<i>Tringa melanoleuca</i>	Birds	Wetlands	-
Great-tailed grackle	<i>Quiscalus mexicanus</i>	Birds	Woodlands, riparian	CSW
Green-tailed towhee* ^{NM}	<i>Pipilo chlorurus</i>	Birds	Scrub, riparian	CSW, SCD
Green-winged teal	<i>Anas crecca</i>	Birds	Wetlands	-
Hairy woodpecker	<i>Picoides villosus</i>	Birds	Ponderosa woodlands	Withdrawn Area, MCG, CSW, SCD
Hammond's flycatcher	<i>Empidonax hammondii</i>	Birds	Wetlands, riparian	CSW, SCD
Harris' sparrow*	<i>Zonotrichia querula</i>	Birds	Scrub, riparian	OR
Hepatic tanager	<i>Piranga flava</i>	Birds	Riparian	CSW, MCG, MC
Hermit thrush	<i>Catharus guttatus</i>	Birds	Riparian, woodlands	CSW, SCD
Hooded merganser	<i>Lophodytes cucullatus</i>	Birds	Wetlands	CSW
Horned grebe	<i>Podiceps auritus</i>	Birds	Wetlands	-
Horned lark	<i>Eremophila alpestris</i>	Birds	Grasslands, wetlands	TA-III, KAFB-West, Assoc. with prairie dogs, CSW, ST, RVR, WTA3, TIJ, OR
House finch	<i>Haemorhous mexicanus</i>	Birds	Altered, riparian	TA-I, TA-V, CSW, SCD, MCG, RG
House sparrow	<i>Passer domesticus</i>	Birds	Altered, scrub	TA-V, CSW
House wren	<i>Troglodytes aedon</i>	Birds	Riparian, woodlands	CSW
Indigo bunting	<i>Passerina cyanea</i>	Birds	Woodlands, riparian	CSW
Juniper titmouse* ^{NM}	<i>Baeolophus ridgwayi</i>	Birds	P-J woodlands, wetlands	Withdrawn Area, CSW, OR, WS, MC

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Killdeer	<i>Charadrius vociferus</i>	Birds	Grasslands	CSW
Ladder-backed woodpecker	<i>Dryobates scalaris</i>	Birds	P-J woodlands	Withdrawn Area, CSW, SCD, RG, WS
Lark bunting* ^{NM}	<i>Calamospiza melanocorys</i>	Birds	Grasslands	-
Lark sparrow	<i>Chondestes grammacus</i>	Birds	Riparian, grasslands	CSW, SCD, OR
Lazuli bunting	<i>Passerina amoena</i>	Birds	Woodlands, riparian	CSW, SCD
Least flycatcher	<i>Empidonax minimus</i>	Birds	Wetlands, riparian	SCD, CSW
Lesser goldfinch	<i>Spinus psaltria</i>	Birds	Riparian, woodlands	CSW, MCG, MC
Lesser scaup	<i>Aythya affinis</i>	Birds	Wetlands	-
Lewis' woodpecker	<i>Melanerpes lewis</i>	Birds	Woodlands	Withdrawn Area
Lincoln's sparrow	<i>Melospiza lincolni</i>	Birds	Scrub, riparian	CSW, SCD, TIJ
Loggerhead shrike*	<i>Lanius ludovicianus</i>	Birds	Grasslands, scrub	TA-I, TA-II, TA-III, WTA3, ST, TA-IV, KAFB-West, KAFB-East, TIJ, CSW, SCD, Assoc. with prairie dogs
Long-billed curlew	<i>Numenius americanus</i>	Birds	Wetlands	-
Long-eared owl	<i>Asio otus</i>	Birds	Ponderosa pine, woodlands	-
Lucy's warbler* ^{NM}	<i>Sturnella lilianae</i>	Birds	Woodlands, riparian	CSW
MacGillivray's warbler	<i>Geothlypis tolmiei</i>	Birds	Woodlands, riparian	CSW, SCD
Mallard	<i>Anas platyrhynchos</i>	Birds	Wetlands	CSW
Marsh wren	<i>Cistothorus palustris</i>	Birds	Wetlands	-
Merlin	<i>Falco columbarius</i>	Birds	Wetlands	CSW
Montezuma quail* ^{NM}	<i>Cyrtonyx montezumae</i>	Birds	Grasslands, mountain woodlands	Withdrawn Area
Mountain bluebird*	<i>Sialia currucoides</i>	Birds	P-J woodlands, riparian	Withdrawn Area, CSW, SCD, MCG, RG, RVR
Mountain chickadee* ^{NM}	<i>Poecile gamebli</i>	Birds	P-J woodlands, wetlands	CSW, SCD, RG, MC
Mourning dove	<i>Zenaida macroura</i>	Birds	Grasslands, altered	TA-I, TA-III, TA-IV, TA-V, Eubank Corridor, CSW, SCD, MCG, RG, RVR, ST, TIJ
Nashville warbler	<i>Leiothlypis ruficapilla</i>	Birds	Woodlands, riparian	CSW
Northern flicker	<i>Colaptes auratus</i>	Birds	Woodlands, wetlands	CSW, SCD, MCG, RG, others

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Northern harrier	<i>Circus hudsonius</i>	Birds	Grasslands	CSW, Assoc. with prairie dogs, ST, RVR
Northern mockingbird	<i>Mimus polyglottos</i>	Birds	Altered, grasslands	TAs, MCG, RG, CSW, SCD
Northern pintail	<i>Anas acuta</i>	Birds	Wetlands	TAGC
Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	Birds	Wetlands, riparian, caves	-
Northern shoveler	<i>Spatula clypeata</i>	Birds	Wetlands	CSW
Northern shrike	<i>Lanius borealis</i>	Birds	Grasslands, scrub	-
Northern waterthrush	<i>Sturnella lilianae</i>	Birds	Woodlands, riparian	CSW
Olive-sided flycatcher*	<i>Contopus cooperi</i>	Birds	Wetlands, riparian	CSW, SCD
Orange-crowned warbler	<i>Sturnella lilianae</i>	Birds	Woodlands, riparian	CSW, SCD
Osprey	<i>Pandion haliaetus</i>	Birds	Wetlands, riparian	-
Painted bunting	<i>Passerina ciris</i>	Birds	Woodland edge, scrub	CSW, SCD
Peregrine falcon	<i>Falco peregrinus</i>	Birds	P-J woodlands	Withdrawn Area, RVR
Pied-billed grebe	<i>Podilymbus podiceps</i>	Birds	Wetlands	-
Pine siskin*	<i>Spinus pinus</i>	Birds	Riparian, woodlands	CSW, SCD, WS
Pinyon jay*	<i>Gymnorhinus cyanocephalus</i>	Birds	P-J woodlands, Wetlands	Withdrawn Area, CSW, SCD, MCG, RG, OR
Plumbeous vireo	<i>Vireo plumbeus</i>	Birds	Ponderosa woodlands	Withdrawn Area, MC, SCD
Prairie falcon	<i>Falco mexicanus</i>	Birds	Grasslands	Assoc. with prairie dogs
Pygmy nuthatch	<i>Sitta pygmaea</i>	Birds	Ponderosa woodlands	Withdrawn Area
Pyrrhuloxia	<i>Cardinalis sinuatus</i>	Birds	Riparian, scrub	CSW, SCD
Red crossbill	<i>Loxia curvirostra</i>	Birds	Ponderosa woodlands	-
Red-breasted nuthatch	<i>Sitta canadensis</i>	Birds	Woodlands	CSW, SCD
Red-naped sapsucker	<i>Sphyrapicus nuchalis</i>	Birds	Woodlands	CSW, SCD
Red-tailed hawk	<i>Buteo jamaicensis</i>	Birds	Woodlands/open	TA-III, KAFB-West, Withdrawn Area, MCG, RG, TIJ, ST
Red-winged blackbird	<i>Agelaius phoeniceus</i>	Birds	Woodlands, riparian	CSW
Ring-necked duck	<i>Aythya collaris</i>	Birds	Wetlands	-
Rock wren* ^{NM}	<i>Salpinctes obsoletus</i>	Birds	P-J woodlands, wetlands	CSW, RG, TIJ
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>	Birds	Woodlands, riparian	CSW
Ruby-crowned kinglet	<i>Regulus calendula</i>	Birds	Riparian, woodlands	CSW, others

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Ruddy duck	<i>Oxyura jamaicensis</i>	Birds	Wetlands	-
Rufous hummingbird	<i>Selasphorus rufus</i>	Birds	Riparian, scrub	CSW, SCD
Rufous-crowned sparrow* ^{NM}	<i>Aimophila ruficeps</i>	Birds	Scrub, riparian	CSW, SCD, RG
Sage thrasher* ^{NM}	<i>Oreoscoptes montanus</i>	Birds	Scrub, riparian	CSW, SCD, TIJ
Sagebrush sparrow* ^{NM}	<i>Artemisiospiza nevadensis</i>	Birds	Desert scrub	TA-III, TIJ, CSW, SCD
Sandhill crane	<i>Grus canadensis</i>	Birds	Wetlands	CSW, OR
Savannah sparrow	<i>Passerculus sandwichensis</i>	Birds	Grasslands	-
Say's phoebe	<i>Saynoris saya</i>	Birds	Grasslands, wetlands	Eubank Corridor, TA-III, WTA3, ST, RVR, Assoc. with prairie dogs, CSW, SCD, MCG, TIJ, WS
Scaled quail*	<i>Callipepla squamata</i>	Birds	Grasslands, desert scrub	TA-III, KAFB-West, KAFB-East, CSW, RG, RVR
Scott's oriole	<i>Icterus parisorum</i>	Birds	Woodlands, riparian	CSW, SCD, OR, WS, MC
Sharp-shinned hawk	<i>Accipiter striatus</i>	Birds	Riparian, grasslands	CSW, SCD
Short-eared owl*	<i>Asio flammeus</i>	Birds	Grasslands	WTA3
Snow goose	<i>Anser caerulescens</i>	Birds	Wetlands	-
Song sparrow	<i>Melospiza melodia</i>	Birds	Scrub, riparian	CSW, SCD, TIJ
Southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	Birds	Wetlands, riparian	CSW
Spotted towhee	<i>Pipilo maculatus</i>	Birds	Shrub, P-J woodlands, ponderosa woodlands	Withdrawn Area, CSW, SCD, MCG, MC, TIJ, WS
Sprague's pipit*	<i>Anthus spragueii</i>	Birds	Grasslands, scrub	
Steller's jay* ^{NM}	<i>Cyanocitta stelleri</i>	Birds	Wetlands, ponderosa pine woodlands	CSW, Withdrawn Area, MCG
Summer tanager	<i>Piranga rubra</i>	Birds	Woodlands, riparian	CSW, MC
Swainson's hawk	<i>Buteo swainsoni</i>	Birds	Woodlands/open	TA-III, KAFB-West, CSW, WTA3, TIJ
Townsend's solitaire* ^{NM}	<i>Myadestes townsendi</i>	Birds	P-J woodlands	Withdrawn Area, MC, MCG, RG, OR, WS
Townsend's warbler	<i>Setophaga townsendi</i>	Birds	Riparian	CSW, SCD
Turkey vulture	<i>Cathartes aura</i>	Birds	Woodlands/open	MCG
Vesper sparrow* ^{NM}	<i>Pooecetes gramineus</i>	Birds	Scrub, riparian	CSW, SCD
Violet-green swallow* ^{NM}	<i>Tachycineta thalassina</i>	Birds	Wetlands	CSW

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Virginia rail	<i>Rallus limicola</i>	Birds	Wetlands	CSW
Virginia's warbler*	<i>Leiothlypis virginiae</i>	Birds	Woodlands, riparian	CSW, SCD
Warbling vireo	<i>Vireo gilvus</i>	Birds	Wetlands	CSW, SCD
Western bluebird*	<i>Sialia mexicana</i>	Birds	P-J woodlands, riparian	Withdrawn Area, CSW, SCD, MCG, RG, OR, WS
Western burrowing owl	<i>Athene cunicularia</i>	Birds	Grasslands	TA-I, TA-II, TA-IV, KAFB-East, KAFB-West, Eubank, RVR, ST, TAGC, assoc. with prairie dogs, SW area, TIJ
Western flycatcher	<i>Empidonax difficilis</i>	Birds	Woodlands, riparian	CSW, SCD
Western kingbird	<i>Tyrannus verticalis</i>	Birds	Grasslands, sparse trees, wetlands	TA-II, TA-IV, Eubank Corridor, CSW, SCD, RVR, TIJ, OR
Western meadowlark	<i>Sturnella neglecta</i>	Birds	Grasslands, riparian	TA-I, TA-II, TA-III, TA-IV, RVR, KAFB-East, KAFB-West, ST, TIJ, OR, CSW
Western screech owl* ^{NM}	<i>Megascops kennicottii</i>	Birds	Ponderosa pine	Withdrawn Area
Western tanager	<i>Piranga ludoviciana</i>	Birds	Woodlands, riparian	CSW, SCD, MCG, MC
Western wood pewee	<i>Contopus sordidulus</i>	Birds	P-J woodlands, wetlands	CSW, SCD, WS, MC
White-breasted nuthatch	<i>Sitta carolinensis</i>	Birds	Riparian, woodlands	CSW, Withdrawn Area, MC
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	Birds	Scrub, riparian	CSW, SCD, MCG, TIJ
White-winged dove	<i>Zenaida asiatica</i>	Birds	Riparian, grasslands	CSW, MCG, MC, RG
Wild turkey	<i>Meleagris gallopavo</i>	Birds	Riparian, grasslands	CSW, MCG
Williamson's sapsucker* ^{NM}	<i>Sphyrapicus thyroideus</i>	Birds	Riparian, open woodlands	CSW, SCD, RG
Willow flycatcher	<i>Empidonax traillii</i>	Birds	Wetlands, riparian	CSW, SCD
Wilson's warbler	<i>Cardellina pusilla</i>	Birds	Woodlands, riparian	CSW, SCD
Woodhouse's scrub-jay* ^{NM}	<i>Aphelocoma woodhousei</i>	Birds	P-J woodlands, wetlands	Withdrawn Area, CSW, SCD, MC, MCG, RG, WS, OR
Yellow warbler	<i>Setophaga petechia</i>	Birds	Woodlands, shrub, riparian	CSW, SCD
Yellow-rumped warbler	<i>Setophaga coronata</i>	Birds	Woodlands, riparian	CSW, SCD, MCG
Zone-tailed hawk	<i>Buteo albonotatus</i>	Birds	Riparian, open woodlands	-

Common Name	Scientific Name	Classification	Habitat Type	Common Known Location(s) within SNL/NM
Abert's squirrel	<i>Sciurus aberti</i>	Mammals: non-bat	Ponderosa woodlands	Withdrawn Area
American badger	<i>Taxidea taxus</i>	Mammals: non-bat	Grasslands	RG, CTF
American black bear	<i>Ursus americanus</i>	Mammals: non-bat	Woodlands	KAFB-East, RG, MCG
American hog-nosed skunk	<i>Conepatus leuconotus</i>	Mammals: non-bat		
Banner-tailed kangaroo rat	<i>Dipodomys spectabilis</i>	Mammals: non-bat	Grasslands	-
Black-tailed jackrabbit	<i>Lepus californicus</i>	Mammals: non-bat	Grasslands	TA-I, TA-II, TA-IV, KAFB-East, KAFB-West, Withdrawn Area, MCG, RG
Bobcat	<i>Felis rufus</i>	Mammals: non-bat	Woodlands	KAFB-East, RG, MCG
Chipmunk	<i>Tamias sp.</i>	Mammals: non-bat		
Coyote	<i>Canis latrans</i>	Mammals: non-bat	Grasslands, altered	TA-I, TA-II, Eubank Corridor, KAFB-West, RG, MCG
Deer mouse	<i>Peromyscus spp.</i>	Mammals: non-bat	Grasslands, wet	CSW
Desert cottontail	<i>Sylvilagus audubonii</i>	Mammals: non-bat	Grasslands, altered	TA-I, TA-II, Eubank Corridor, RG
Elk	<i>Cervus canadensis</i>	Mammals: non-bat	Woodlands	Withdrawn Area, MCG
Gray fox	<i>Urocyon cinereoargenteus</i>	Mammals: non-bat	Woodlands	KAFB-East, RG, MCG
Gunnison's prairie dog	<i>Cynomys gunnisoni</i>	Mammals: non-bat	Grasslands	TA-I, TA-II, TA-IV, KAFB-East, KAFB-West, Eubank, RVR, ST, TAGC, SW area
Hispid cotton rat	<i>Sigmodon hispidus</i>	Mammals: non-bat	Grasslands	CSW
Javelina	<i>Pecari tajacu</i>	Mammals: non-bat	Grasslands, woodlands	MCG
Kit fox	<i>Vulpes macrotis</i>	Mammals: non-bat	Grasslands	-
Merriam's kangaroo rat	<i>Dipodomys merriami</i>	Mammals: non-bat	P-J scrub, grasslands	TA-V, KAFB-West
Mexican wolf	<i>Canis lupus baileyi</i>	Mammals: non-bat	Grasslands, woodlands	KAFB
Mountain lion	<i>Puma concolor</i>	Mammals: non-bat	Woodlands	RG, MCG, KAFB, Withdrawn Area
Mule deer	<i>Odocoileus hemionus</i>	Mammals: non-bat	Woodlands	RG, MCG, KAFB, Withdrawn Area
North American porcupine	<i>Erethizon dorsatum</i>	Mammals: non-bat		TA-I

Common Name	Scientific Name	Classification	Habitat Type	Common Known Location(s) within SNL/NM
Northern grasshopper mouse	<i>Onychomys leucogaster</i>	Mammals: non-bat	Grasslands	-
Ord's kangaroo rat	<i>Dipodomys ordii</i>	Mammals: non-bat	Grasslands, wet	TA-III, TA-IV, TA-V, KAFB-West, CSW
Raccoon	<i>Procyon lotor</i>	Mammals: non-bat	Grasslands, altered	, TA-I, TA-II, TA-IV
Ringtail	<i>Bassariscus astutus</i>	Mammals: non-bat		RG, KAFB-East, Withdrawn Area
Rock squirrel	<i>Otospermophilus variegatus</i>	Mammals: non-bat	Woodlands, altered	TA-I, Withdrawn Area, RG
Silky pocket mouse	<i>Perognathus flavus</i>	Mammals: non-bat	Grasslands	TA-II
Southern plains woodrat	<i>Neotoma micropus</i>	Mammals: non-bat	Grasslands	KAFB-East, RG
Southern pocket gopher	<i>Thomomys umbrinus</i>	Mammals: non-bat	Grasslands	TA-IV
Spotted ground squirrel	<i>Spermophilus spilosoma</i>	Mammals: non-bat	Grasslands	TA-I-V
Striped skunk	<i>Mephitis mephitis</i>	Mammals: non-bat	Grasslands, altered	TA-II, TA-II, TA-IV, RG, MCG
Texas antelope squirrel	<i>Ammospermophilus interpres</i>	Mammals: non-bat	Grasslands	RG
Western harvest mouse	<i>Reithrodontomys megalotis</i>	Mammals: non-bat	Grasslands, wet	CSW
Western spotted skunk	<i>Spilogale gracilis</i>	Mammals: non-bat	Grasslands	RG, MCG
White-footed mouse	<i>Peromyscus leucopus</i>	Mammals: non-bat	Grasslands	-
White-tailed deer	<i>Odocoileus virginianus</i>	Mammals: non-bat	Woodlands	MCG
Allen's lappet-eared bat	<i>Idionycteris phyllotis</i>	Mammals: Bat		Rare, 2010 (SNL 2011a)
Arizona myotis	<i>Myotis occultus</i>	Mammals: Bat		
Big brown bat	<i>Eptesicus fuscus</i>	Mammals: Bat		CSW, TAGC
Big free-tailed bat	<i>Nyctinomops macrotis</i>	Mammals: Bat		
California myotis	<i>Myotis californicus</i>	Mammals: Bat		
Canyon bat	<i>Parastrellus hesperus</i>	Mammals: Bat		CSW, TAGC
Desert pallid bat	<i>Antrozous pallidus</i>	Mammals: Bat		ST
Eastern red bat	<i>Lasiurus borealis</i>	Mammals: Bat		
Fringed myotis	<i>Myotis thysanodes</i>	Mammals: Bat		
Hoary bat	<i>Lasiurus cinereus</i>	Mammals: Bat		CSW, TAGC
Little brown myotis	<i>Myotis lucifugus</i>	Mammals: Bat		
Long-eared myotis	<i>Myotis evotis</i>	Mammals: Bat		

Common Name	Scientific Name	Classification	Habitat Type	Common Known Location(s) within SNL/NM
Long-legged myotis	<i>Myotis volans</i>	Mammals: Bat		KAFB
Mexican free-tailed bat	<i>Tadarida brasiliensis</i>	Mammals: Bat		CSW, TAGC
Pale Townsend's big-eared bat	<i>Corynorhinus townsendii pallescens</i>	Mammals: Bat	P-J Woodlands, caves, mines, and rock shelters	Withdrawn Area
Pocketed free-tailed bat	<i>Nyctinomops femorosaccus</i>	Mammals: Bat		
Silver-haired bat	<i>Lasionycteris noctivagans</i>	Mammals: Bat		CSW, TAGC, TA-V
Southwestern myotis	<i>Myotis auriculus</i>	Mammals: Bat		
Spotted bat	<i>Euderma maculatum</i>	Mammals: Bat	P-J Woodlands	Withdrawn Area
Tricolored bat	<i>Perimyotis subflavus</i>	Mammals: Bat		CSW, TAGC
Western mastic bat	<i>Eumops perotis</i>	Mammals: Bat		
Western red bat	<i>Lasiurus blossevillei</i>	Mammals: Bat		
Western small-footed bat	<i>Myotis ciliolabrum</i>	Mammals: Bat		CSW, Withdrawn Area
Western yellow bat	<i>Lasiurus xanthinus</i>	Mammals: Bat		
Yuma myotis	<i>Myotis yumanesis</i>	Mammals: Bat		TAGC

* Indicates Partners in Flight Conservation Concern Species (Rosenberg et al. 2016).

^a This list is not a dataset of current species occurrence or sightings within SNL/NM managed lands.

Location Key: CSW: Coyote Springs Wetland, CTF: Coyote Test Field, KAFB: Kirtland Air Force Base, MC: Madera Canyon, MCG: Madera canyon guzzler, OR: KAFB Viewpoint, RG: Range guzzler, RVR: Robotics Vehicle Range, SCD: Old SC Dome, ST: NSTTF Solar Tower, SW Area: southwest corner of KAFB, TA: Technical Areas I, -II, -III, -IV, -V), TAGC: Tijeras Arroyo Golf Course, TIJ: Tijeras Arroyo, WTA3: West and Southwest of TA-III, WS: Winch Site.

Source: Cruz-Carretero and Cruz-McDonnell 2015; eBird 2023; Hauer et al. 2018; KAFB 2013; Malaney et al. 2024; McMurry and Smith 2023; Perry et al. 2012; SNL 2011a; SNL 2012c; SNL 2015b; SNL 2016b; SNL 2017a; SNL 2017c; SNL 2018d; SNL 2018g; SNL 2020c; SNL 2020d; SNL 2022g; SNL 2022h; SNL 2023g; USFS 2013a; USFS 2013b; USFS 2022.

Birds

All native, migratory birds are protected by the MBTA. EO 13186 gives additional emphasis to protecting birds. In 2013, DOE signed a Memorandum of Understanding with USFWS promoting monitoring, habitat enhancement, and protection of migratory birds, including considerations for migratory birds in the design of sustainable buildings and facilities (SNL 2015d; KAFB 2023; and 78 FR 34534). About 43–47 percent of reported bird deaths at SNL/NM are attributed to window strikes (SNL 2018d; SNL 2020d; and KAFB 2023).

Raptors and other large bird species in particular can suffer from collisions and electrocution from powerlines that do not comply with Avian Power Line Interaction Committee (APLIC) (2012) Guidelines. The most recent KAFB INRMP (KAFB 2023) states that power lines pose an electrocution and collision risk to avian species, and all high-risk structures on SNL/NM have not been fully raptor proofed. A 2014 survey of pole hazard risk determined that 70 of the 3,009

poles were found potentially hazardous to raptors (KAFB 2014). Two poles were responsible for three known mortalities (Chihuahuan raven [*Corvus cryptoleucus*], peregrine falcon [*Falco peregrinus*], and great blue heron [*Ardea herodias*]) and received the highest recommendation to be retrofitted. The survey found that none of the distribution poles with crossarms met the APLIC recommended standards for clearance in golden eagle (*Aquila chrysaetos*) habitat (APLIC 2012 and KAFB 2014). Since the 2014 survey, several of the poles with electrocution and collision hazards have been replaced with underground conductors.

Table A-22 describes estimated avian mortality from various sources in the United States as detailed in a 2016 study (Walston et al. 2016) at utility-scale solar energy facilities.

Table A-22. Estimated Annual Avian Mortality from Various Sources in the United States

Mortality Source	Estimate of Annual Mortality	Reference
Utility-scale solar energy developments	37,800–138,600 ^a	SEIA (2015)
Wind energy developments	140,000–573,000	Loss et al. (2013a); Smallwood (2013); Erickson et al. (2014)
Fossil fuel power plants	14.5 million	Sovacool (2009)
Communication towers	4.5–6.8 million	Erickson et al. (2005); Longcore et al. (2012)
Pesticides	17–91 million	Mineau (2005)
Roadway vehicles	89–340 million	Loss et al. (2014b)
Buildings and windows	365–988 million	Loss et al. (2014a)
Free-ranging domestic cats	1.3–4 billion	Loss et al. (2013b)

a. Based on about 14 gigawatt total name plate capacity of utility-scale solar facilities in operations or under construction across the United States (SEIA 2015).

Source: Adapted from Walston et al. (2016).

A.4.8.3.1 Grassland and Shrubland Birds

At least 60 species of grassland birds use SNL/NM grasslands, which provide valuable habitat for species that rely on grasslands during different seasons (Cruz-Carretero and Cruz-McDonnell 2015). Grassland birds are declining throughout the United States (e.g., Sauer et al. 2013 and Rosenberg et al. 2019), with downward trends for birds such as Chihuahuan meadowlarks (*Sturnella lilianae*) and western meadowlarks (*Sturnella neglecta*) locally on SNL/NM, illustrated by monitoring data from 2003–2015 (SNL 2016a). Eastern and Chihuahuan meadowlarks have declined nationally 75 percent in the past 50 years (Rosenberg et al. 2019).

Of the 20 most common North American birds with the greatest population declines since 1967, 7 currently occur on SNL/NM lands. Five of these species in significant decline depend on good pure grassland stands or quality grasslands with a shrub component. These species include Chihuahuan meadowlark, loggerhead shrike (*Lanius ludovicianus*), black-throated sparrow (*Amphispiza bilineata*), lark sparrow (*Chondestes grammacus*), and horned lark (*Eremophila alpestris*) (SNL 2015b).

The scaled quail (*Callipepla squamata*), a desert grassland species, declined from 40–70 individuals observed during North American Breeding Bird Surveys (2003–2007) to zero in

2015 (SNL 2015d and SNL 2016a). This decline may be due to environmental stochasticity (random fluctuation) because the population increased in subsequent years (SNL 2018f; SNL 2018g; and SNL 2023a).

Other grassland birds have shown stable or increasing trends at SNL/NM (SNL 2016a). Detections of grassland/shrub/open woodland species such as western kingbird (*Tyrannus verticalis*), black-throated sparrow, and Cassin's kingbird (*Tyrannus vociferans*) increased at SNL/NM from 2003–2015 during breeding season (SNL 2016a). Black-throated sparrow and horned lark populations are declining nationwide (e.g., Sauer et al. 2013), so localized increases in population point to the importance of SNL/NM habitats. Another grassland bird that frequently occurs at SNL/NM is Cassin's sparrow (*Peucaea cassinii*), a species that nests on short-grass prairie with scattered shrubs. This species is on the Continental Partners in Flight Watch List, indicating a high conservation concern throughout its range (Rosenberg et al. 2016).

Some bird species are associated with prairie dogs, including northern harrier (*Circus hudsonius*), golden eagle, prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius*), burrowing owl, loggerhead shrike, horned lark, and Chihuahuan meadowlark. As discussed in Chapter 4, Section 4.8.2.3.1, of this SWEIS, Gunnison's prairie dogs (*Cynomys gunnisoni*) have declined dramatically throughout their range due to eradication efforts; their populations have declined locally on SNL/NM in recent years (SNL 2018g), which may adversely affect birds that nest in association with prairie dog towns.

Raptor species known to hunt and roost in the SNL/NM grassland habitat include the northern harrier, red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), ferruginous hawk (*Buteo regalis*), American kestrel, prairie falcon, great horned owl (*Bubo virginianus*), barn owl (*Tyto alba*), and burrowing owl. The lack of nesting sites (e.g., trees and cliffs) limits the use of this habitat for raptor breeding except for the burrowing owl. However, some species may occasionally use man-made structures for nesting, including nest boxes for barn owls and great horned owls, which have been monitored since 2011 (SNL 2022g). Tall, isolated structures located in the middle of remote grassland areas, such as telephone and electrical poles and abandoned and active test structures, provide ideal roosting sites for birds of prey, but they may also cause electrocution without proper raptor-proofing (APLIC 2012; KAFB 2014; SNL 2015b; and KAFB 2023).

SNL/NM has been identified as an Important Bird Area by the Audubon Society and is recognized internationally as a valuable conservation area by BirdLife International (Audubon 2025). The Important Bird Area Program is a global effort to identify and conserve areas vital to birds and other biodiversity (SNL 2015b). This designation is largely because of the site's importance to gray vireos and burrowing owls, as discussed in Chapter 4, Sections 4.8.1.2, 4.8.2.2 and 4.8.3.2.2, of this SWEIS.

A.4.8.3.2 Pinyon-Juniper and Ponderosa Woodland Birds

Pinyon-juniper provides breeding habitat for 19 bird species of conservation concern identified by Partners in Flight (Rosenberg et al. 2016), which has ranked the state's pinyon-juniper habitat as Priority A (Highest Level of Concern). Eight of these species that use pinyon-juniper as

primary breeding habitat are found at SNL/NM. Three pinyon-juniper woodland bird species that reside in the Withdrawn Area are defined as Forest Service Sensitive Species: gray vireo (*Vireo vicinior*), peregrine falcon (*Falco peregrinus*), and American goshawk (*Accipiter gentilis*) (USFS 2013a and SNL 2020c). The ponderosa habitat within the Withdrawn Area provides breeding habitat for well over 50 bird species (SNL 2015b; KAFB 2023; and McMurry and Smith 2023).

Non-Federally Listed Birds of Conservation Concern: As detailed in Chapter 4, Section 4.8.1.2, of this SWEIS, the pinyon-juniper (and to a lesser extent, ponderosa pine) habitat available particularly in the Withdrawn Area supports numerous sensitive bird species. These include eight species that are designated Partners in Flight Conservation Concerns: gray vireo (also state threatened) (NMDGF 2024), juniper titmouse, pinyon jay, Woodhouse's scrub jay, western bluebird, mountain bluebird, crissal thrasher, and black-throated gray warbler (Rosenberg et al. 2016). Four pinyon-juniper woodland bird species that reside in the Withdrawn Area are defined as Forest Service Sensitive Species: gray vireo, peregrine falcon, American goshawk, and golden eagle (SNL 2020c). Under the Sikes Act Improvement Act of 1997, species of concern like the pinyon jay in New Mexico must be monitored and managed for conservation on federal lands, including DoD lands (16 U.S.C. § 670, e.g., Novak et al. 2021).

The American peregrine falcon is listed as state threatened by NMDGF (NMDGF 2024) and Sensitive by the Forest Service, though it was delisted from the federal list of endangered and threatened wildlife on August 25, 1999 (64 FR 46542). Suitable nesting cliffs can be found in the canyons of the Withdrawn Area to the east, and breeding activity has been documented in the area. Peregrine falcons have nested in the Withdrawn Area and likely other locations, and SNL/NM biologists have observed peregrine falcons regularly at SNL/NM (SNL 2010b; SNL 2011b; SNL 2012b; SNL 2013; SNL 2014; SNL 2015d; SNL 2016a; SNL 2017b; SNL 2018f; SNL 2019; SNL 2020b; SNL 2021a; SNL 2022g; and SNL 2023a). At least one peregrine falcon was killed by electrocution at a poorly fitted utility pole (KAFB 2014).

The ponderosa pine woodlands of the Manzanita Mountains contain marginal habitat for the American goshawk, a Forest Service Sensitive Species. Habitat conditions conducive to the occurrence of another Forest Service Sensitive Species, the flammulated owl, have been identified in Bonito Canyon. Both have been recorded as present in the Withdrawn Area (SNL 2020c and eBird 2023).

The gray vireo, a state threatened species as listed by NMDGF (NMDGF 2024) and a Forest Service Sensitive Species, nests throughout the juniper woodland community at elevations of 5,850–6,600 feet. The 2023 gray vireo monitoring report identified 104 territories, with 81 nests (McMurry and Smith 2023). SNL/NM, especially the Withdrawn Area, including Lurance Canyon, is reported to have the largest gray vireo breeding colony in New Mexico, mainly in the eastern portion in juniper savanna (Harris et al. 2020; Harris et al. 2021; Harris et al. 2022; and McMurry and Smith 2023). KAFB has conducted gray vireo monitoring surveys every year during 2003–2021. Coordination with the SNL/NM Ecology Program for gray vireo management has occurred from 2007 to the present (KAFB 2023).

Western burrowing owl is a State SGCN (New Mexico), a Forest Service Sensitive Species, a USFWS Bird of Conservation Concern, and a BLM State Sensitive Species. SNL/NM has

important grassland habitat for this species, which has experienced significant habitat losses with expanding development in the Albuquerque area (SNL 2010b; SNL 2015b; and KAFB 2023). It is closely associated with prairie dog colonies (using abandoned burrows for nesting) and is on the decline throughout most of its range. This species has been reported in TA-II and TA-III and KAFB, and recently in the southwestern portion of SNL/NM (McMurry and Smith 2023). Burrowing owl populations at SNL/NM have declined since 1998 (when 52 breeding pairs were noted, compared to the latest assessment that estimated 24 territories) (McMurry and Smith 2023). The total number of burrowing owl fledglings at SNL/NM decreased from 157 in 2007 to an estimated 67 fledglings in 2023 (McMurry and Smith 2023), but annual fluctuations can be dramatic. Various proposed causes for declines include high predation rates, habitat loss, military activities, a decrease in prairie dog colonies, use of rodenticide, drought, migration, and loss of over-winter habitats (e.g., Ongman et al. 2019; McMurry et al. 2021; McMurry et al. 2022). Data from annual burrowing owl reports suggest that the number of fledglings is correlated to the amount of precipitation in previous years, as well as the number of active prairie dog colonies (e.g., SNL 2011a; SNL 2012c; SNL 2015c; Ongman et al. 2019; Lundblad et al. 2022). Lundblad et al. (2022) documented the importance of recruitment of prior years' fledglings back into the breeding population and immigration, as burrowing owls exist in a metapopulation.

Another New Mexico State SGCN and Forest Service Sensitive Species that nests in association with prairie dog towns is the mountain plover (*Charadrius montanus*). Although not known to occur on SNL/NM, an adult and two chicks were observed just south of SNL/NM on the Pueblo of Isleta in 2003, and the SNL/NM INRMPs (SNL 2015c and KAFB 2023) reported that mountain plovers may potentially be found in the southern grasslands of the base, especially during brood-rearing and/or migration.

Birds and other wildlife are at risk of aircraft strikes, especially given the location of the SNL/NM in the Rio Grande flyway, and with the abundance of wildlife habitat in the Region of Influence (ROI). The Bird/Wildlife Aircraft Strike Hazard (BASH) Plan is a high priority within the KAFB INRMP (KAFB 2023). During FY 2000–FY 2005, there were 51 BASH incidents (USACE 2018). Species included the sage thrasher (*Oreoscoptes montanus*), chestnut-collared longspur (*Calcarius ornatus*), horned lark, plumbeous vireo (*Vireo plumbeus*), barn swallow (*Hirundo rustica*), and rock wren (*Salpinctes obsoletus*) (USACE 2018).

A.4.8.3.3 Mammals

Some representative mammal species observed in undeveloped parts of TAs I–V include spotted ground squirrel (*Spermophilus spilosoma*) and desert cottontail (*Sylvilagus audubonii*). Rodents such as Ord's kangaroo rat (*Dipodomys ordii*) have been found in TA-III and TA-V. Black-tailed jack rabbits (*Lepus californicus*), mule deer (*Odocoileus hemionus*), and elk (*Cervus canadensis*) have been observed in multiple areas, including the Withdrawn Area. Coyotes (*Canis latrans*) have been observed throughout the grassland habitats. Mammalian predators such as bobcat (*Felis rufus*), gray fox (*Urocyon cinereoargenteus*), mountain lion (*Puma concolor*), and black bear (*Ursus americanus*) have been found in the Withdrawn Area (SNL 2023a and McMurry and Smith 2023).

A.4.8.4 Wetlands

KAFB wetlands (refer to Figure A-27) were designated as jurisdictional wetlands under Section 404 of the CWA, because their soils, hydrology, and vegetation met the regulatory definition. No natural lakes or rivers are on KAFB, although there are several wetlands and springs. Since the delineations, additional springs and seeps have been encountered on KAFB-managed lands that require jurisdictional assessment. Six manmade ponds are on TAGC. (Marcus et al. 2006).

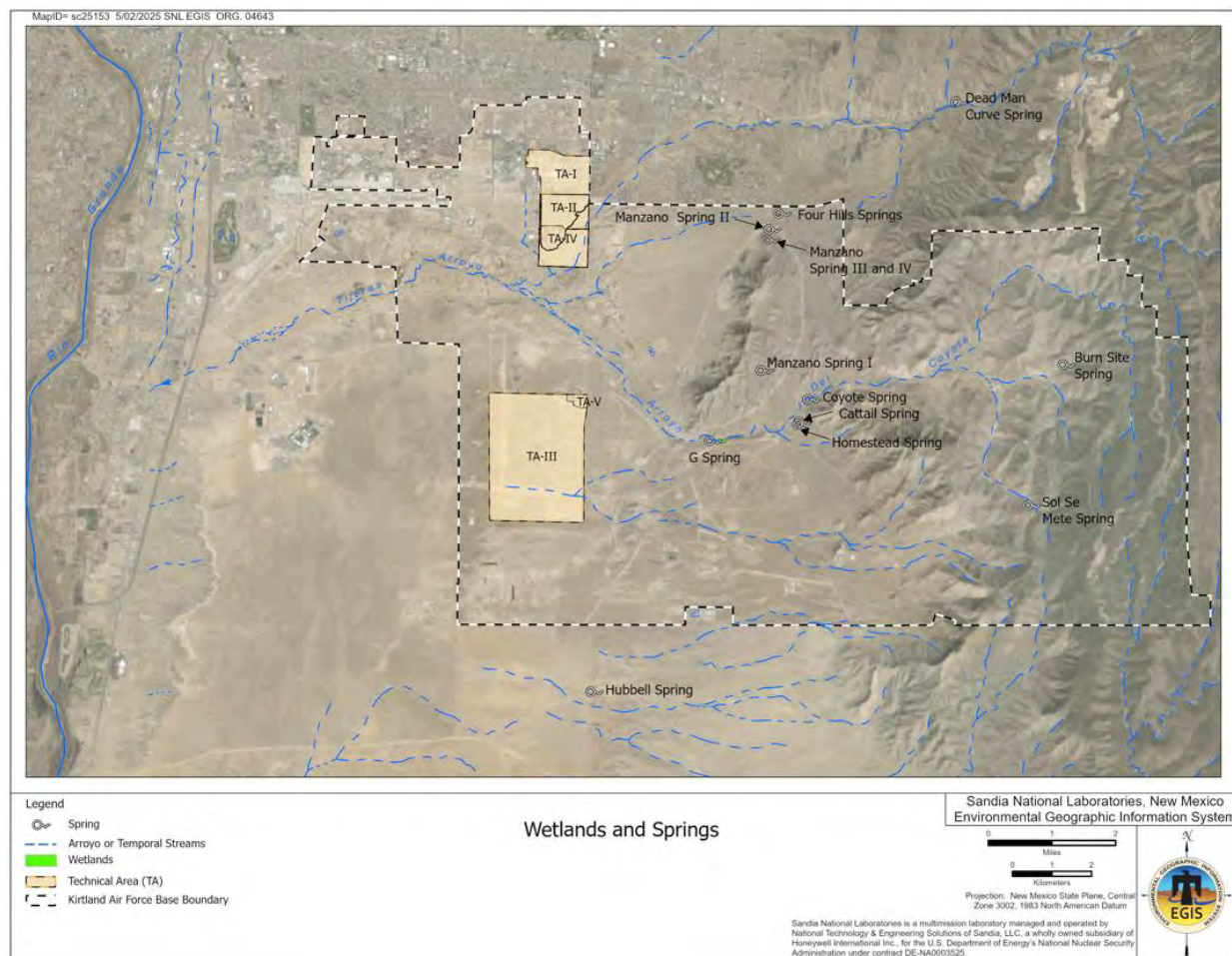


Figure A-27. Wetlands and Springs on KAFB

A.4.9 Cultural and Paleontological Resources

This section provides general background data on cultural resources and historic properties within SNL/NM-managed lands. A total of 206 archaeological sites with historic components have been identified.

The NMHPD (2021) and NPS (1997) recognize six broad types of historic contexts for cultural resources in New Mexico: Precontact, Spanish Colonization, Mexican Period, Territorial Era,

Statehood through the Great Depression, and Midcentury. Historical properties are only considered for past human activities or events 50 years old or older, although there are exceptions for properties that have achieved significance within the past 50 years if they are of exceptional importance or are integral parts of districts eligible for listing in the National Register of Historic Places (NRHP) (Criteria Consideration G).

Historical properties are evaluated for inclusion in the NRHP using four criteria specified in 36 CFR 60.4:

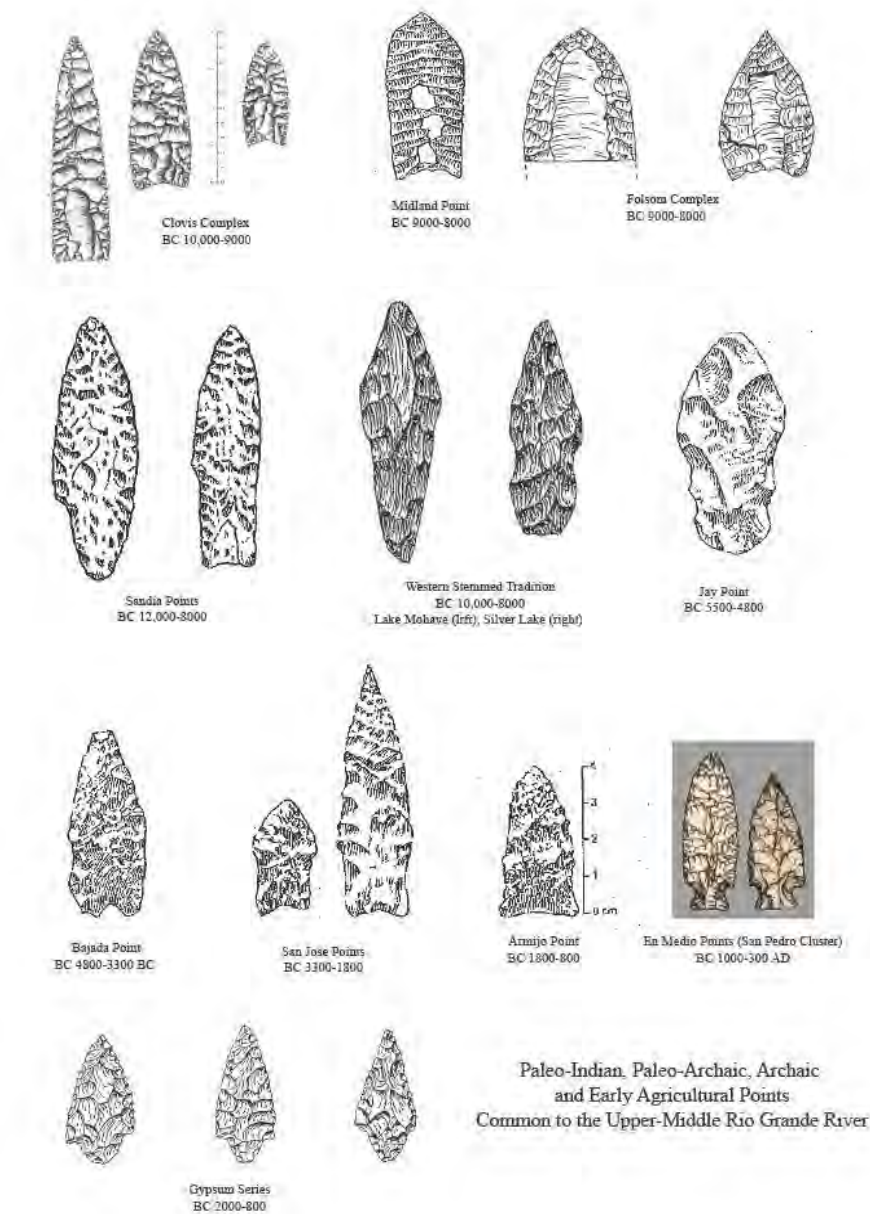
The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, properties, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

- A. That are associated with events that have made a significant contribution to the broad patterns of our history; or
- B. That are associated with the lives of persons significant in our past; or
- C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- D. That have yielded, or may be likely to yield, information important in prehistory or history.

A.4.9.1 Paleo-Indian Period (Pre-10,000 to 5,500 BC)

New Mexico has a rich heritage of the earliest humans in North America, commonly referred to as Paleo-Indians. Some of the earliest Paleo-Indian radiocarbon dates in the Nation, at about 20,000 years ago, were reported from Sandia Cave about 15 miles northeast of Albuquerque, although reevaluations of the data suggest an occupation no earlier than 14,000 years ago. Important investigations were also conducted at Blackwater Draw near Portales, where ancient Clovis hunters preyed on now-extinct mammoths from about 11,000–12,000 years ago, and at Folsom, now referred to as the Folsom Complex, which has an assigned temporal range from about 10,000–11,000 years ago and where a now-extinct form of bison (*Bison antiquus*) was the preferred prey of hunters. Paleo-Indian manifestations from 10,000–7,500 years ago are commonly subsumed within the umbrella term Plano Complex (or simply as Late Paleo-Indian), with time periods named after diagnostic points defined in Great Plains contexts (Cordell and McBrinn 2012 and Kornfeld et al. 2010).

Within the SNL/NM area, seven sites have been assigned to the Paleo-Indian period based on the presence of distinctive projectile points (refer to Figure A-28), although in four instances they co-occur with much more recent occupations and might reflect collection and curation of older artifacts by more recent groups. One was identified as a Folsom point, another as a Midland Point (a non-fluted version of Folsom), and two as Late Paleo-Indian points. Two points were not identified as to type or age.



Source: Cordell and McBrinn (2012); Frison (1991); Projectilepoints.net 2024; and Spangler and Zweifel (2021).

Figure A-28. Illustrations of Projectile Points Discussed in Sections A.4.9.1, A.4.9.2, and A.4.9.3

A.4.9.2 Archaic Period (5500 BC to AD 400)

“Archaic” is a term that applies both to a period of time (from ca. 5500 BC to the advent of farming at 1500 BC to AD 400, depending on the area) and a way of life (broad-based hunting and gathering of wild plant foods) (Cordell and McBrinn 2012). It is most recognized by the

appearance of ground stone tools (manos and metates) in aceramic contexts, mostly through cross-dating of certain projectile points that have been recovered in radiocarbon-dated contexts elsewhere. Archaeologists have divided the Archaic into a number of periods, phases, series, traditions, and complexes, but these are simply organizational devices based on projectile point differences, even if the hunting and gathering behaviors remained the same over many millennia. This analysis defers to the organizational scheme offered by Huckell (1996) that delineates three Archaic periods: Early Archaic (5500 to 3500 BC), Middle Archaic (3500 to 1500 BC), and Late Archaic (1500 BC to AD 400).

The transition from food procurement (hunting and gathering) to food production (farming of domesticates and animal husbandry) marked a fundamental change in human behavior during the Late Archaic time period, leading to increased sedentism, increased social complexity, population aggregations, and increased competition for arable lands and water resources.

Evidence of early agriculture has been documented within SNL/NM-managed lands and KAFB. There have been 13 sites identified that are mostly artifact scatters with diagnostic Late Archaic points and ground stone tools. Diagnostic artifacts include Armijo, En Medio, and Gypsum Series points, all of which were used by Late Archaic foragers and contemporaneous early farmers. The absence of evidence for early farming suggests SNL/NM-managed lands were exploited by foragers, some of whom might also have practiced limited farming elsewhere in the region (Spangler and Zweifel 2021).

A.4.9.3 Ancestral Puebloan Period (AD 400 to 1540)

The Ancestral Puebloan Period is generally distinguished from the Late Archaic/Early Agricultural Period by the introduction of ceramics, which first appeared in the Rio Grande Valley between AD 400 and 600 in the form of plain gray wares and brown wares. Archaeologists have organized the voluminous data within the context of the Rio Grande Classification System, which defines four sequential sub-periods: Developmental Period from AD 400–1200, Coalition Period from AD 1200–1325, Classic Period from AD 1325–1600, and Historic Period after AD 1540–1600 (Okun 2021 and Peckham 1984).

The Early Developmental Period (AD 400–900) was characterized by the appearance of gray ware and brown ware ceramics and bow-and-arrow technologies, the emergence of aggregated pit-house villages, and a shift in settlement patterns to broad valley bottoms, alluvial terraces, and river benches. The Late Developmental Period (AD 900–1200) featured a transition from pit-houses to above-ground pueblos, although pit-houses continued to be used in the Middle Rio Grande Valley, usually with standardized floor features such as four-post roof supports, ladder holes, and sipapus (Cordell and McBrinn 2012). Ceramics common at this time included Red Mesa Black-on-white and Socorro Black-on-white (OAS 2025).

The Coalition Period (AD 1200–1325) was characterized by substantial population increases, perhaps due to immigration from the San Juan Basin, and by the establishment of year-round settlements at higher elevations. Settlements were larger than any previous ones, and many of the pueblos occupied at the time of Spanish Contact originated during the Coalition Period when the Rio Grande Valley emerged as one of the largest population centers in the American Southwest

(Okun 2021). Coalition Period features include roomblocks for residences and storage, check dams along arroyos, cobble terraces, and grid gardens. Diagnostic ceramics reflect a replacement of mineral paint with organic paint with Socorro Black-on-white and Santa Fe Black-on-white being common diagnostic markers (OAS 2025).

The Classic Period (AD 1325–1600) was characterized by continued aggregation into even larger pueblos, often clustered in groups of 5 to 13 pueblos, all organized around open plazas and kivas. Some pueblos contained as many as 2,000 rooms. Population growth and increased social complexity at this time have been attributed to the abandonment of the San Juan Basin and northern Colorado Plateau and the consequent arrival of groups with different linguistic and ethnic compositions. This period also featured increasingly complex agricultural practices to enhance water retention, reduce erosion, and enhance crop yields. Some fields were located a significant distance from the pueblos, mandating the use of seasonal residences referred to as “field houses” (Cordell and McBrinn 2012 and Okun 2021).

At least 95 sites on SNL/NM-managed lands have been assigned to the Developmental, Coalition, and Classic Periods, almost always based on ceramic evidence and, in some cases, architectural traits. Most of these are artifact scatters that might be associated with foraging activities, but many others are associated with roomblocks, pit-houses, field houses, and check dams. These features indicate the area was also used for agriculture and that Ancestral Puebloan groups have occupied this area for the past 1,500 years. Based on evidence elsewhere in the upper Rio Grande Valley, these occupations were likely intermittent, representing multiple episodes of establishment, abandonment, re-establishment, and re-abandonment (refer to Cordell and McBrinn 2012 for a detailed discussion of the social, climatic, and environmental conditions that prompted the cycles of occupation and abandonment).

A.4.9.4 Historic Period (AD 1540 to Present Day)

The 1540–1542 entrada of Francisco Vazquez de Coronado was the first official European entry into the present Albuquerque area and denotes the beginning of the current Historic Period. The expedition found 12 large pueblos clustered along the Rio Grande between present-day Bernalillo and the Pueblo of Isleta and several smaller villages to the south. Although Spanish settlement of the Rio Grande Valley and adjacent areas increased steadily between 1610 and 1680, life was far from peaceful. Hostility erupted leading to the Pueblo Revolt of 1680 that saw the Spanish officials, settlers, and Franciscan missionaries flee the region (Sanchez et al. 2013).

By 1692, the Spanish had begun to reassert control of the lost territory through brutal military campaigns, although many pueblos continued to resist through 1696. The Spanish conquest was followed by the in-migration of thousands of Spanish settlers and the establishment of scores of new communities and military outposts. Albuquerque was founded in 1704, originally named Villa de San Francisco Albuquerque (Sanchez et al. 2013).

The 1700s saw a gradual warming of Spanish-Puebloan relations as both groups faced a common threat: systematic raiding by Utes, Apaches, Navajos, and Comanches (Sanchez et al. 2013). The Apaches and the Comanches often used Tijeras Canyon and the Sandia and Manzano mountains to stage raids on Spanish and Pueblo communities. Due to the high frequency of these raids, the

Spanish governor authorized the settlement of San Miguel del Laredo (San Miguel) at the western end of Tijeras Canyon for protection. Some families who settled at San Miguel in 1817 settled along San Antonio Creek, which is a tributary of Tijeras Creek.

By the nineteenth century, the area along the Rio Grande between present-day Bernalillo and the Pueblo of Isleta, including the east side of the Sandia Mountains, was occupied primarily by ranchers and miners. However, a small community, Coyote Springs, was established in the vicinity of a natural spring along the Arroyo del Coyote. Mining began in the nineteenth century and extended well into the twentieth century (Lintz et al. 1988). Gold, silver, and copper were mined from Hells Canyon between 1880 and 1910, and lead and fluorspar were mined in Coyote Canyon and gold was mined in Tijeras Canyon from 1910 to the 1930s.

The first airfield, Oxnard Field, was constructed in 1928, and by 1939 it was being used frequently by military flights for refueling. As tensions mounted with Japan in 1941, the U.S. Army acquired Oxnard Field as a training depot for aircraft mechanics, renaming it Albuquerque Army Airfield. New runways were added in 1942, and it was renamed Kirtland Army Airfield, and later Kirtland Air Force Base after the creation of the DAF in 1947. The Army acquired additional lands around the airfield for what became the New Mexico Proving Ground.

At the conclusion of World War II in 1945, the Los Alamos laboratory that was part of the Manhattan Project was reorganized, and ordnance engineering activities were separated into Z Division, which was moved to Albuquerque Army Airfield. In 1948, Z Division was redesignated as SNL. That same year, SNL/NM opened TA-I and TA-II to support weapon assembly missions. TA-III was established in 1954 for environmental and developmental testing, and in the 1960s, TA-IV and TA-V were created to house pulsed power facilities and nuclear reactor research and testing, respectively. By the 1970s, the mission had evolved to include R&D of fossil fuels and alternative energy (Alberts 1985).

A.4.9.5 Historic Sites by Historic Theme

All historic contexts defined by NMHPD (2021) have been identified within SNL/NM-managed lands, although the Spanish Colonization and Mexican Period contexts are represented by a single mining site (LA 47869) that had artifacts and features attributed to all five historic contexts. The New Mexico Archaeological Records Management Section identified a total of 76 sites that are historic in nature or are sites where historic artifacts and/or features occur alongside prehistoric artifacts and/or features (refer to Appendix A, Section A.4.9). Most historic artifacts date from about AD 1912–1945, or the beginning of the Statehood era to the end of World War II. The number of historic sites for each historic theme on SNL/NM-managed lands is included in Table A-23.

Table A-23. Historic Sites by Historic Theme

Historic Theme ^a	Eligible Sites	Unevaluated Sites ^b	Not Eligible Sites	Total
Other: Domestic	5	4	9	18
Industry: Mining	11	1	20	32
Agriculture	4	3	2	9

Historic Theme ^a	Eligible Sites	Unevaluated Sites ^b	Not Eligible Sites	Total
Military	2	0	1	3
Transportation	2	1	2	5
Government	0	0	1	1
Water Control	1	0	0	1
Not Specified	2	8	2	12
TOTALS	27	17	37	81

a. Totals reflect the total number of sites with those individual themes, but five sites have multiple themes and were counted for each theme.

b. Unevaluated sites are considered eligible until New Mexico SHPO determines otherwise.

Source: SNL 2023h.

A.4.9.6 Historic Built Environment Resources

Approximately 770 facilities are currently being managed for their historic qualities or their potential to become historic properties in the future. Most of these are organized within the context of seven proposed historic districts:

The proposed Aerial Cable Historic District, within KAFB-East, has a period of significance of 1965–1989 and features properties with utilitarian, bunker-like appearances. In consultation with New Mexico SHPO, DOE determined that three historic properties constructed in 1965 were eligible for listing in the NRHP under Criterion A.

The proposed Early Sandia Historic District, within TA-I, has a period of significance of 1948–1958, although the period of significance for some properties continues into the present. It features SNL/NM's initial period of permanent construction. Properties contributing to this district are related to administration, weapons design, military liaison, environmental tests, and non-weapons research. DOE, in consultation with New Mexico SHPO, has determined that 26 sites are eligible for National Register listing under Criteria A and C. DOE has recommended three additional structures as eligible under the same criteria, but it has not yet consulted with New Mexico SHPO regarding them.

The proposed Explosives Testing Historic District, in the CTF, has a period of significance from 1959–1989, although some historic integrity was lost in 1981 when major renovations occurred. The facilities feature rugged, reinforced concrete designs needed to research the physics of explosive blasts. DOE, in consultation with New Mexico SHPO, has determined that three sites are eligible for National Register listing under Criteria A and/or C.

The proposed National Solar Thermal Test Facility Historic District, within KAFB-West, has a period of significance from 1980–2010. Properties contributing to this district are related to SNL/NM's pioneering research into efficient, effective solar energy generation, a mission that continues into the present. Four buildings (a tower, a control building, an assembly building, and an engine test facility) were determined eligible for National Register listing by DOE in consultation with New Mexico SHPO under Criterion A.

The proposed Pulsed Power Historic District, part of TA-IV, has a period of significance from 1979 to the present. Properties contributing to this district are associated with environmental testing; stockpile stewardship; and research into x-ray, gamma-ray, and particle beam fusion. Four historic buildings (a simulation technical lab, a particle beam fusion facility, a particle beam accelerator, and a components development lab) were determined eligible for National Register listing by DOE in consultation with New Mexico SHPO under Criteria A and/or C.

The proposed Reactor Complex Historic District, part of TA-V, has a period of significance of 1961–1989. Properties contributing to this district are related to providing nuclear reactor support for environmental testing of weapons components and materials in radiation environments and support for weapons materials research. Historic properties were determined eligible for National Register listing by DOE in consultation with New Mexico SHPO under Criteria A and/or C.

The proposed TA-III Historic District has a period of significance of 1954–1989. Properties assigned to this district reflect nuclear-weapons-related environmental testing activities directly related to the Cold War. In consultation with New Mexico SHPO, DOE determined that 24 historic properties were eligible for National Register listing under Criteria A and/or C.

Additionally, outside of proposed historic districts, two SNL/NM properties have been determined eligible for National Register listing: Building 858N, a radiation-hardening integrated circuits building, and Building 871, an electromagnetics environmental testing building.

A.4.10 Traffic and Transportation

A.4.10.1 Transportation Infrastructure

The current bus routes available to/around KAFB/SNL/NM are:

- 31 Wyoming (direct),
- 157 Louisiana / Montañito / Northwest Transit Center (direct), and
- 222 Rio Bravo – Rail Runner Station (via transfer).

SNL/NM employees have five primary means to travel to and from work: driving alone (roughly 75 percent), carpooling (about 10 percent), using public transportation (<5 percent), walking/biking (<5 percent), or driving a motorcycle (<5 percent). The regional road network in Albuquerque includes two major interstates: I-25, which runs north-south about 1.5 miles west of KAFB/SNL/NM, and I-40, which runs east-west about 1 mile north of KAFB/SNL/NM (Figure A-29). According to the *2035 Metropolitan Transportation Plan* (MRCOG 2014 and MRCOG 2017), various portions of I-25 and I-40 in the vicinity of KAFB/SNL/NM are over capacity (have a ratio of traffic volume to road capacity between 1.0 and 1.09) during peak hours (7–9 a.m. and 4–6 p.m.) and are projected to continue to exceed capacity through 2035. Across New Mexico, I-25 and I-40 are maintained by the New Mexico Department of Transportation (NMDOT).

Access to KAFB/SNL/NM consists of an urban road network maintained by the City of Albuquerque. The four major north-south arterials providing access to KAFB/SNL/NM are San Mateo Boulevard, Louisiana Boulevard, Wyoming Boulevard, and Eubank Boulevard. The primary east-west arterial is Gibson Boulevard (refer to Figure A-29). The Gibson, Wyoming, and Eubank Boulevard Corridors are all classified by the Mid-Region Council of Governments as being in the 30 most congested corridors in the Albuquerque metropolitan planning area (MRCOG 2014). Along Eubank Boulevard, congestion is classified as moderate-to-severe near the approach to KAFB/SNL/NM's Eubank Gate entrance. Along Wyoming Boulevard, congestion is classified as minor-to-moderate near the approach to the Wyoming Gate entrance. Along Gibson Boulevard's approaches to KAFB/SNL/NM, congestion is classified as moderate-to-severe near the Truman Gate entrance, minor near the Gibson Gate entrance, and moderate near the infrequently used Carlisle Gate entrance. The formerly utilized South-Valley Gate access off of I-25 is closed. Table A-24 provides additional information on average daily traffic.

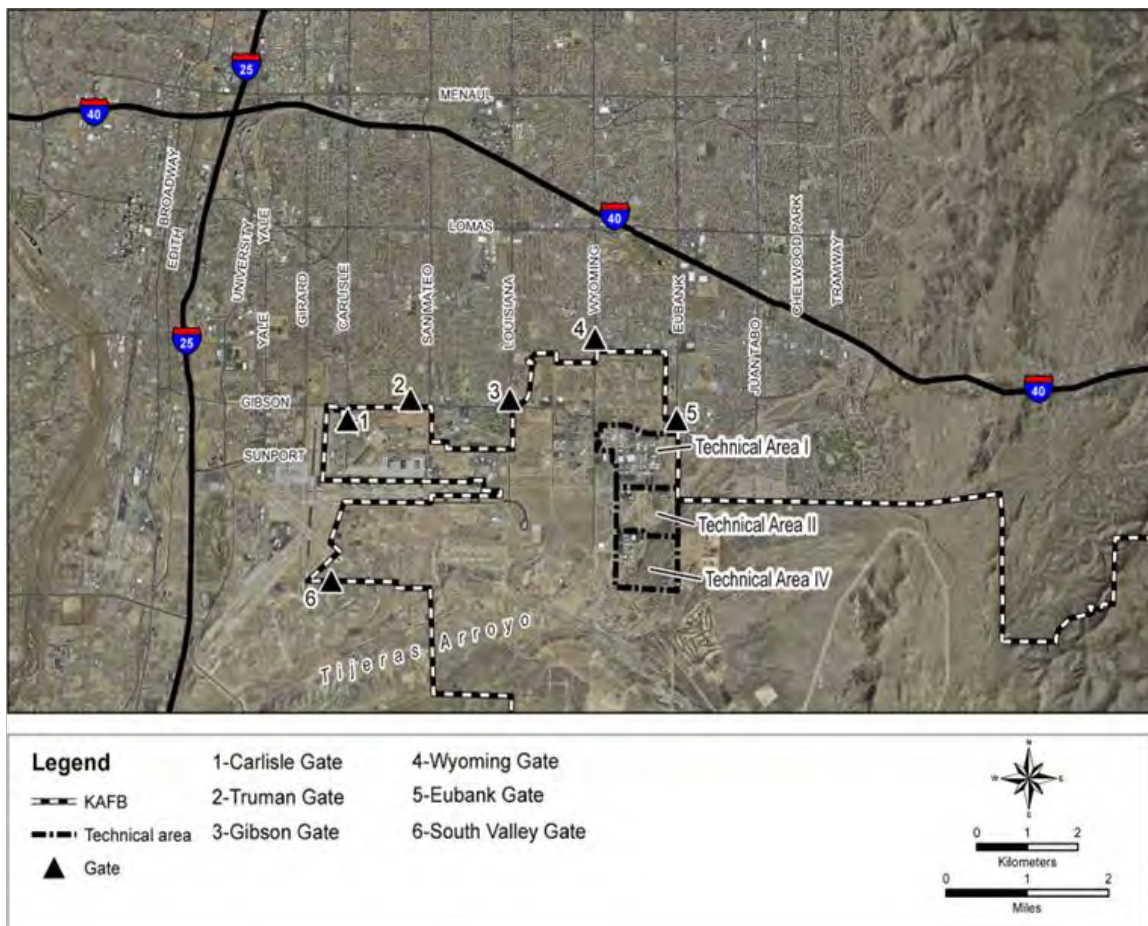


Figure A-29. Gate Locations and Primary Arterial Roadways to KAFB/SNL/NM

Table A-24. Annual Average Daily Traffic for Principal SNL/NM Access Routes/Intersections during 2018–2022

Access Route	Average Annual Daily Traffic (2018–2022)	% Trucks (2018–2022)	Level of Service ^a during Peak Usage Times
I-40 at Eubank Blvd	43,207	7%	B
I-40 at Wyoming Blvd	30,504	7%	B
Intersection of Eubank Blvd and Central Ave	28,923	5%	C
Intersection of Eubank Blvd and Innovation Parkway (Eubank Gate area)	22,279	5%	E
Intersection of Wyoming Blvd and Central Ave	16,520	7%	C
Intersection of Wyoming Blvd and Susan Ave (Wyoming Gate area)	7,034	7%	D
Intersection of Gibson Blvd and Louisiana Blvd (Gibson Gate area)	17,062	7%	C
Intersection of Gibson Blvd and San Mateo Blvd (Truman Gate area)	53,210	7%	D

a. Level of Service is a qualitative descriptor of traffic conditions in terms of such factors as speed and travel time, delays, freedom to maneuver, traffic interruptions, comfort, convenience, and safety. Letter designations are assigned from A to F, with A representing the best operating conditions (free-flow) and F the worst (severely congested flow with high delays).

Source: NMDOT 2019; NMDOT 2020; NMDOT 2021; NMDOT 2022a; NMDOT 2022b; and NMDOT 2023.

Table A-24 summarizes recent NMDOT average weekday traffic volume counts at various major nearby utilized corridors and intersections for commuting to and from SNL/NM.

As detailed in Figure A-29, SNL/NM is accessible only by road; there is no rail or water access to the site. KAFB/SNL/NM is essentially bounded by University Boulevard to the west, Gibson Boulevard to the north, Tribal Road-201 to the south, and the Manzano Mountain Range to the east. Figure A-30 shows public transit options to reach the site.

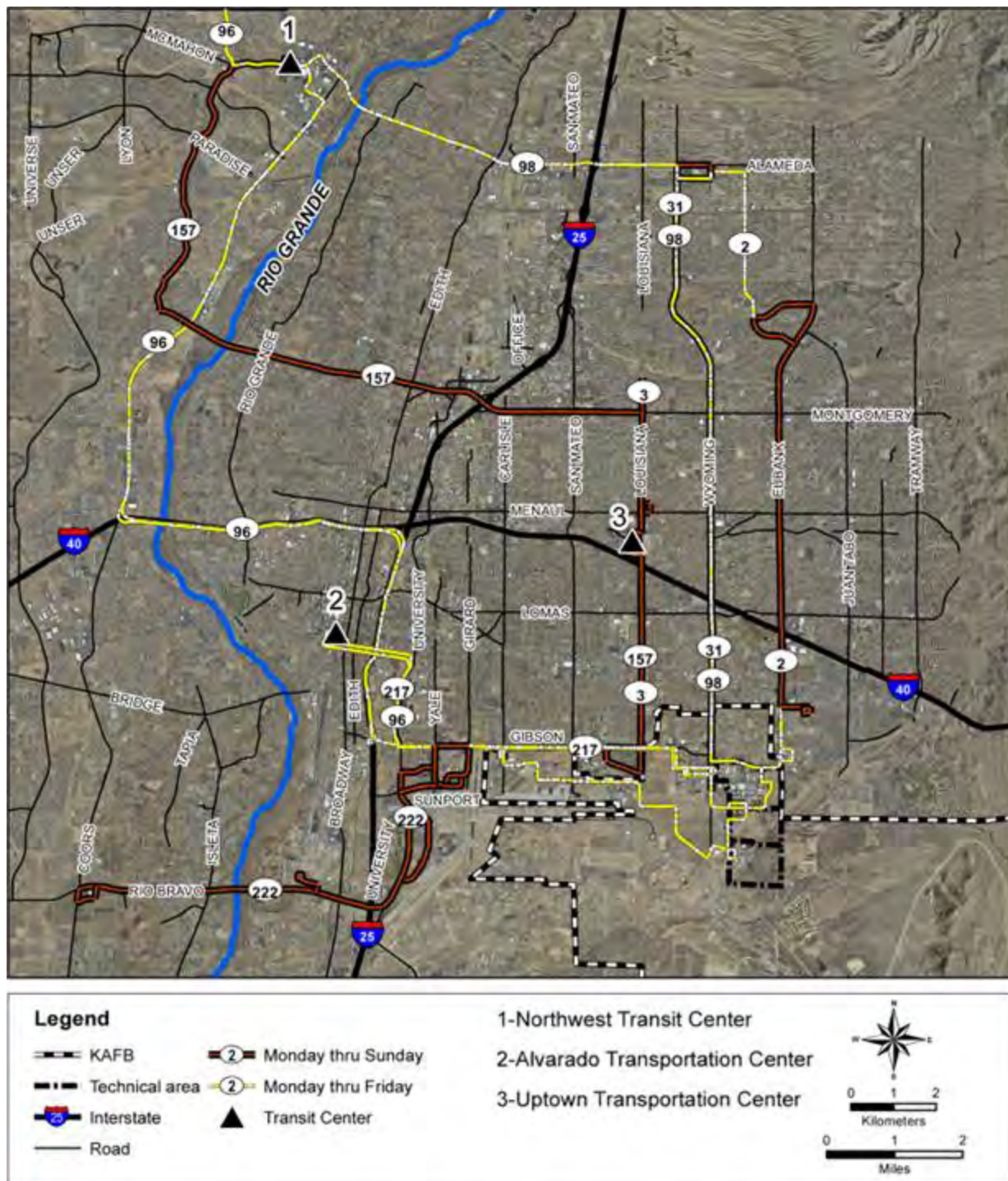
SNL/NM, in concert with established protocols across the NNSA Complex, emphasizes and provides considerable employee outreach, initiatives, and metrics related to site transportation, including SNL/NM federal vehicle fleet use onsite, vanpool opportunities, carpool opportunities, GHG emission reductions, bicycle-friendly roadway rules, bicycle rack and locker capacity, electric bicycle use, incentives implemented, incentives used, and employee satisfaction surveys.

During FY 2022, SNL/NM achieved a 26-percent reduction of GHG emissions associated with employee travel from FY 2021 and continued to pilot a telework program that is reducing emissions from vehicular commuting (SNL 2022i).

As of the end of FY 2022, SNL/NM's onsite fleet size totaled 898 vehicles; 3 of them are electric. Planned acquisition of additional all-electric vehicles in FY 2022 did not occur, however, because of supply chain delays and the lack of available vehicles from manufacturers and the General Services Administration. Nevertheless, the availability of onsite charging infrastructure was recently increased for all electric and plug-in hybrid electric vehicles. Two solar-powered Level 2 charging stations, each with the capacity for two vehicles, were installed

at SNL/NM during FY 2022. SNL/NM now maintains a total of seven solar Level 2 stations. Moreover, there are eight Level 1 hard-wired electric vehicle charging stations located onsite, each with one charging port, and two Level 2 hard-wired electric vehicle charging stations, each with two charging ports (SNL 2022i).

In addition, SNL/NM acquired 34 solar-powered electric carts in FY 2022.



Source: CABQ 2023.

Figure A-30. Locations of Public Transit Routes Serving KAFB/SNL/NM

A.4.10.2 Aviation Based Shipping

The Transshipment Facility, on permitted property in KAFB-West, receives and stages specific programmatic materials for an external customer. Materials are staged for shipment to SNL/NM storage locations or shipped to offsite locations. Materials may be non-hazardous or hazardous based on the definition in DOT regulations at 49 CFR 171.8 and 49 CFR Part 173, Subparts C and D. All DOT hazard classes from 1–9 could be present. All materials remain in DOT-approved containers and are not opened. This facility handles up to 12 tasks (material transfer actions) per year, and each task contains up to 17 463L pallets.²⁴ These tasks are related to transportation only, and no material is taken into SNL/NM inventory systems. All materials are handled in compliance with separation and segregation requirements found in 49 CFR 177.848. The facility operates in accordance with SNL Corporate Policy.

A.4.10.3 Offsite Waste Shipments

SNL/NM ships offsite all DOT 49 CFR hazard classifications. Hazardous and radioactive wastes, including but not limited to LLW and TRU wastes, are also transported offsite from SNL/NM. The offsite facilities that accepted LLW/mixed low-level waste (MLLW) for the period 2018–2021 are provided in Table A-25. The offsite facilities that accepted hazardous waste for the period 2018–2021 are provided in Table A-26.

Table A-25. Offsite Facilities that Accepted SNL/NM LLW/MLLW, 2018–2021

Facility Name	Location	Offsite Shipments (2018)	Offsite Shipments (2019)	Offsite Shipments (2020)	Offsite Shipments (2021)
NNSS	Mercury, Nevada	8	4	7	6
Perma-Fix Environmental Services – DOE CAP-accredited commercial facility	Gainesville, Florida	1	1*	0	1*
Perma-Fix DSSI/M&EC – DOE CAP-accredited commercial facility	Kingston, Tennessee	0	1*	0	1*
TOTALS	-	9	6	7	8

M&EC: East Tennessee Materials & Energy Corporation subsidiary to Perma-Fix DSSI)

* Some shipments are transported from SNL/NM to Perma-Fix/Tennessee then on to Perma-Fix/Florida. When this is the case, it has been counted as one total shipment.

Source: SNL 2023i.

²⁴ The 463L pallet is a standardized pallet used for transporting military air cargo with dimensions of 108 inches by 88 inches; it is made of a balsa wood core with aluminum skin.

Table A-26. Offsite Facilities that Accepted SNL/NM Hazardous Waste, 2018–2021

Facility Name	Location	Offsite Shipments (2018)	Offsite Shipments (2019)	Offsite Shipments (2020)	Offsite Shipments (2021)
Battery Solution	Arizona	0	2	0	0
Cirba Solutions	Arizona	0	0	0	0
Superior Special Services	Arizona	0	0	0	0
Veolia	Arizona	6	4	6	6
Veolia	Colorado	15	17	24	18
Perma-Fix	Florida	1	2	0	2
Veolia	Illinois	3	2	1	1
Clean Harbors-Colfax	Louisiana	2	1	2	1
NNSS	Nevada	1	1	3	2
U.S. Ecology	Nevada	2	5	1	1
Keers	New Mexico	8	10	0	0
Safety Kleen	New Mexico	10	0	0	0
Soilutions	New Mexico	3	0	0	0
Stericycle	New Mexico	8	0	0	0
SWTF	New Mexico	0	0	0	0
Thermo Fluids	New Mexico	0	0	0	0
Perma-Fix (M&EC)	Tennessee	0	0	0	2
Alpha Omega Recycling	Texas	1	1	2	1
Intergulf	Texas	0	2	0	0
SET Environmental	Texas	1	1	0	0
Stericycle	Utah	0	0	0	0
ESTIMATED TOTALS		61	48	39	34

Source: SNL 2023i.

A.4.11 Infrastructure

Table A-27 shows the amount of onsite electrical production for the period 2017 through 2022.

Table A-27. Onsite Electrical Generation by Year (in MWh)

Year	Site Total Electrical Usage	Onsite Electrical Production	Onsite Generation Type
FY 2017	245,298	723	PV
FY 2018	242,537	724	PV
FY 2019	252,011	959	PV
FY 2020	266,405	899	PV
FY 2021	273,341	845	PV
FY 2022	280,328	1,017	PV
Totals	1,559,921	5,169	

Source: SNL 2023j.

A.4.12 Materials Management and Waste Management

A.4.12.1 Materials Management

A.4.12.1.1 Chemical Information Tool

SNL/NM personnel use a comprehensive chemical information tool for tracking workplace chemical and biological containers by location. The primary drivers for the tracking system are state and federal regulations and laws, including the Emergency Planning and Community Right-to-Know Act. The tool compiles information on chemical hazards and appropriate protective measures for Emergency Management Operations, other ES&H programs, and the workforce. The inventory system provides the chemical or product name, location, and quantity and identifies who is responsible for the chemical. Chemical hazards are reported on safety data sheets, and the tool currently contains more than 125,000 safety data sheets in its library. This electronic inventory helps employees and their managers assess and manage workplace hazards. Easy access to this inventory facilitates availability searches. It also improves the ability to share chemicals and thus aids in reducing sources, which helps to minimize chemical purchases and waste disposal expenses.

The Chemical Exchange Program was developed in 1989 as a hazardous waste minimization program. This program has been through multiple transformations since its inception, and in 2008, the Chemical Exchange Program was introduced as a module within the chemical information tool. The goal is to reduce the amount of usable chemicals disposed of as waste and instead make them available for reuse, thereby lowering the cost of both new acquisitions and disposal (SNL 2022g).

A.4.12.2 Waste Management

A.4.12.2.1 Radioactive Waste

Table A-28 through Table A-33 show the major generators of radioactive waste at SNL/NM for 2017–2022. The tables include non-radioactive and radioactive wastes generated at these facilities.

Table A-28. 2022 Non-Radioactive and Radioactive Waste Generation (lb) by Major Contributors and Special Projects

Major Generators	Routine Classified Non-Rad Haz	Non-Routine Classified Non-Rad Haz	Routine Classified Non-Rad Non-Haz (Solid)	Non-Routine Classified Non-Rad Non-Haz (Solid)	Routine LLW	Non-Routine LLW	Routine Mixed Waste	Non-Routine Mixed Waste	Routine TRU	Non-Routine TRU	Routine TRU Mixed	Non-Routine TRU Mixed	Grand Total
B-61	5,360	0	9,120	0	27,286	0	6,111	0	0	0	0	0	47,877
Neutron Generator Facilities	189	0	2,227	0	5,247	0	6,947	0	0	0	0	0	14,610
R&D, Defense Programs	1,579	0	986	0	2,240	0	552	0	0	0	0	0	5,357
Research Accelerator Facilities, TA-IV	0	0	0	0	23,233	0	3,602	0	0	0	0	0	32,084
Research Reactor Facilities, TA-V	0	0	0	0	0	372	4,796	0	0	0	0	0	5,168
RMWMU Waste Operations	0	0	0	0	4,397	0	0	0	0	0	0	0	4,397
RPSD Lab Waste	0	0	0	0	3,311	0	359	0	0	0	0	0	3,670
Other	2,543	0	7,905	0	1	0	14	0	0	0	0	0	10,463
Grand Total	9,671	0	20,238	0	65,714	372	22,381	0	0.01	0	0	0	123,627

Note: Values may not sum due to rounding.

Table A-29. 2021 Non-Radioactive and Radioactive Waste Generation (lb) by Major Contributors and Special Projects

Major Generators	Routine Classified Non-Rad Haz	Non-Routine Classified Non-Rad Haz	Routine Classified Non-Rad Non-Haz (Solid)	Non-Routine Classified Non-Rad Non-Haz (Solid)	Routine LLW	Non-Routine LLW	Routine Mixed Waste	Non-Routine Mixed Waste	Routine TRU	Non-Routine TRU	Routine TRU Mixed	Non-Routine TRU Mixed	Grand Total
B-61	1,505	0	5,670	0	553	0	7,579	0	0	0	0	0	15,307
Neutron Generator Facilities	1,527	0	380	0	2,403	0	2,860	0	0	0	0	0	7,169
R&D, Defense Programs	211	0	6,935	0	949	0	4	0	0	0	0	0	8,099
Research Accelerator Facilities, TA-IV	0	0	0	0	8,268	0	4,520	0	0	0	0	0	15,906
Research Reactor Facilities, TA-V	0	0	0	0	2,372	0	134	199	0	0	0	0	2,706
RMWMU Waste Operations	0	0	0	0	2,981	0	780	0	0	0	0	0	3,761
RPSD Lab Waste	0	0	0	0	4,155	0	76	0	0	0	0	0	4,231
Other	2,177	0	1,275	0	80	0	2	0	0	0	0	0	3,533
Grand Total	5,420	0	14,259	0	21,760	0	15,955	199	0.1	0	0	0	60,712

Note: Values may not sum due to rounding.

Table A-30. 2020 Non-Radioactive and Radioactive Waste Generation (lb) by Major Contributors and Special Projects

Major Generators	Routine Classified Non-Rad Haz	Non-Routine Classified Non-Rad Haz	Routine Classified Non-Rad Non-Haz (Solid)	Non-Routine Classified Non-Rad Non-Haz (Solid)	Routine LLW	Non-Routine LLW	Routine Mixed Waste	Non-Routine Mixed Waste	Routine TRU	Non-Routine TRU	Routine TRU Mixed	Non-Routine TRU Mixed	Grand Total
B-61	11,410	0	12,804	0	17,322	0	4,650	0	0	0	0	0	46,185
Neutron Generator Facilities	451	0	90	0	3,829	0	3,035	0	0	0	0	0	7,404
R&D, Defense Programs	583	0	7,748	0	1,125	5,493	648	399	0	0	0	0	15,996
Research Accelerator Facilities, TA-IV	0	0	0	0	8,746	0	5,411	0	0	0	235	0	17,686
Research Reactor Facilities, TA-V	0	0	0	0	1,987	56	3,531	21	0	0	0	0	5,595
RMWMU Waste Operations	0	0	0	0	269	841	235	0	0	0	0	0	1,345
RPSD Lab Waste	0	0	0	0	2,977	0	0	0	0	0	0	0	2,977
Other	5,354	0	1,863	0	0	11,102	96	0	0	0	0	0	18,415
Grand Total	17,798	0	22,505	0	36,256	17,492	17,605	420	0	0	235	0	115,605

Note: Values may not sum due to rounding.

Table A-31. 2019 Non-Radioactive and Radioactive Waste Generation (lb) by Major Contributors and Special Projects

Major Generators	Routine Classified Non-Rad Haz	Non-Routine Classified Non-Rad Haz	Routine Classified Non-Rad Non-Haz (Solid)	Non-Routine Classified Non-Rad Non-Haz (Solid)	Routine LLW	Non-Routine LLW	Routine Mixed Waste	Non-Routine Mixed Waste	Routine TRU	Non-Routine TRU	Routine TRU Mixed	Non-Routine TRU Mixed	Grand Total
B-61	1,961	0	6,281	0	1,876	0	2,072	0	0	0	0	0	12,189
Neutron Generator Facilities	14	0	694	0	3,235	0	2,107	0	0	0	0	0	6,049
R&D, Defense Programs	521	0	4,702	0	2,739	0	5,982	0	0	0	0	0	13,945
Research Accelerator Facilities, TA-IV	0	0	0	0	8,647	0	2,650	0	0	0	0	0	11,297
Research Reactor Facilities, TA-V	0	0	0	0	4,145	0	1,570	0	0	0	0	0	5,714
RMWMU Waste Operations	0	0	0	0	665	0	58	0	0	0	0	0	723
RPSD Lab Waste	0	0	0	0	3,197	0	190	0	0	0	0	0	3,387
Other	7,581	0	3,481	0	0	0	2,451	105	0	0	0	0	13,618
Grand Total	10,077	0	15,158	0	24,503	0	17,079	105	0	0	0	0	66,921

Note: Values may not sum due to rounding.

Table A-32. 2018 Non-Radioactive and Radioactive Waste Generation (lb) by Major Contributors and Special Projects

Major Generators	Routine Classified Non-Rad Haz	Non-Routine Classified Non-Rad Haz	Routine Classified Non-Rad Non-Haz (Solid)	Non-Routine Classified Non-Rad Non-Haz (Solid)	Routine LLW	Non-Routine LLW	Routine Mixed Waste	Non-Routine Mixed Waste	Routine TRU	Non-Routine TRU	Routine TRU Mixed	Non-Routine TRU Mixed	Grand Total
B-61	1,222	0	2,590	0	5,846	0	855	0	0	0	0	0	10,512
Neutron Generator Facilities	59	0	273	0	3,108	0	5,553	0	0	0	0	0	8,992
R&D, Defense Programs	865	0	6,613	0	7,759	0	506	0	0	0	0	0	15,743
Research Accelerator Facilities, TA-IV	0	0	0	0	1,911	0	1,902	0	0	0	0	0	4,859
Research Reactor Facilities, TA-V	0	0	0	0	7,707	0	9,454	0	0	0	0	0	17,160
RMWMU Waste Operations	0	0	0	0	1,087	1,440	46	0	0	0	0	0	2,573
RPSD Lab Waste	0	0	0	0	4,283	0	117	0	0	0	0	0	4,399
Other	4,523	0	6,831	0	160	0	5,511	0	0	0	1	0	17,026
Grand Total	6,669	0	16,306	0	31,859	1,440	23,942	0	0	0	1	0	81,264

Note: Values may not sum due to rounding.

Table A-33. 2017 Non-Radioactive and Radioactive Waste Generation (lb) by Major Contributors and Special Projects

Major Generators	Routine Classified Non-Rad Haz	Non-Routine Classified Non-Rad Haz	Routine Classified Non-Rad Non-Haz (Solid)	Non-Routine Classified Non-Rad Non-Haz (Solid)	Routine LLW	Non-Routine LLW	Routine Mixed Waste	Non-Routine Mixed Waste	Routine TRU	Non-Routine TRU	Routine TRU Mixed	Non-Routine TRU Mixed	Grand Total
B-61	5,329	0	7,940	0	8,608	0	204	0	0	0	0	0	22,081
Neutron Generator Facilities	320	0	407	0	5,452	0	2,207	0	0	0	0	0	8,386
R&D, Defense Programs	43	0	1,061	0	33	0	1,044	0	0	0	0	0	2,180
Research Accelerator Facilities, TA-IV	0	0	0	0	11,979	0	3,696	0	0	0	0	0	16,725
Research Reactor Facilities, TA-V	0	0	0	0	6,906	6,570	2,615	114	0	0	0	0	16,205
RMWMU Waste Operations	0	0	0	0	2,213	116	0	0	0	0	0	0	2,329
RPSD Lab Waste	0	0	0	0	3,621	0	1,425	0	0	0	0	0	5,046
Other	229	0	859	0	1	13,500	0	0	0	0	0	0	14,589
Grand Total	5,921	0	10,267	0	38,813	20,186	11,190	114	0	0	0	0	87,541

Note: Values may not sum due to rounding.

Certain types of explosive waste generated at SNL/NM are treated at the TTU or Radioactive and Mixed Waste Management Unit (RMWMU). Other explosive waste generated at SNL/NM is generally managed at the point of generation until it is shipped to an offsite facility for treatment in accordance with regulatory requirements (SNL 2022g). SNL/NM personnel operate the TTU, a small open burn unit in TA-III that is permitted for treatment of certain explosive waste generated by research and test activities at the LIHE Facility. Explosive wastes are treated at the TTU via open burning as soon as possible after generation and are not stored at the LIHE Facility or at the TTU. Onsite treatment by open burning at the TTU is required for waste generated at the adjacent LIHE Facility because the particular explosive waste is reactive (RCRA D003). DOT forbids the transportation of the reactive explosive waste, and therefore, SNL/NM must meet the RCRA treatment standard of deactivation onsite. The residue that is no longer explosive or reactive that was derived from treatment at the TTU is small amounts of ash left in the burn pan. This residue is collected, containerized, and accumulated pending periodic pickup and management as hazardous waste because it contains silver (SNL 2023k). Between 2017 and the present, most other SNL/NM explosive hazardous waste was collected, containerized, stored, and shipped in compliance with DOT requirements for RCRA treatment and disposal at an offsite TSDF. The remaining explosive wastes at SNL/NM are treated at the RMWMU either by thermally inerting (heating them) or through chemical deactivation in an enclosed “boom box” unit through enclosed burning or detonation. Table A-34 shows the weight of explosive waste treated at SNL/NM during the period 2017–2021.

Table A-34. Explosive Waste Treated at SNL/NM (2017–2021)

Facility	Treatment	2017	2018	2019	2020	2021
TTU	Open burning	628 kg	596 kg	450 kg	555 kg	840 kg
RMWMU	Making inert through heat or enclosed burning or detonation in a boom box	0	0	0	10	0

Source: SNL 2023k.

A.4.12.2.2 New Mexico Special Waste

Asbestos Wastes. Asbestos-containing material (ACM) is present in older (pre-1989) buildings, and abatement is ongoing. ACM is removed only when it presents an inhalation hazard or the building is slated to be torn down or renovated. Building materials containing asbestos are present in floors, ceilings, roofing tile, certain types of insulation, and other fire-retardant construction materials; these are typical asbestos wastes generated during abatement in buildings. Typical asbestos waste generated from equipment abatement is the ACM found in fume hoods, ovens, and cable insulation. If laboratory equipment has ACM in good condition and in a non-friable form (which poses no inhalation risk), these items may remain in service or be redistributed through the SNL/NM Property Management and Reapplication Department (SNL 2022j).

Infectious Waste. Waste from SNL/NM medical activities and facilities is processed through the HWHU and then ultimately transported to permitted offsite TSDFs after generation. All DOT requirements are met (SNL 2010c).

A.4.12.2.3 Toxic Substances Control Act Waste

TSCA addresses the production, import, use, and disposal of specific chemicals, including PCBs and asbestos (15 U.S.C. § 2601 et seq.). Electrical equipment (e.g., capacitors and light ballasts) is evaluated for PCBs when taken out of service (SNL 2022g). In recent years (2017–2021), PCB waste was shipped to Veolia ES Technical Solutions LLC in Phoenix, Arizona. SNL/NM is responsible for recordkeeping and reporting on the import or export of small quantities of chemicals used for SNL/NM research activities and the disposal of PCB-containing substances. PCBs are a class of organic chemicals, regulated under TSCA, that were used widely in past industrial applications due to their physical and chemical properties. PCBs were used in dielectric fluids (e.g., fluids in transformers or capacitors), hydraulic fluids, and other applications requiring stable, fire-retardant materials. The domestic production and distribution of PCBs were banned in 1979, and their use continues to be phased out. Most PCBs and PCB-containing equipment at SNL/NM have been identified and replaced. There are currently no known PCB-containing items remaining in use that require tracking in accordance with regulations. Former locations of electrical transformers since removed from service will undergo future remediation.

A.4.12.2.4 Used Oil

Used oil is managed as other regulated waste. From 2017–2022, no used oil was shipped to TSDFs for disposal but instead was recycled. Used oil was not disposed of onsite at SNL/NM.

A.4.13 Human Health and Safety

This section is reserved.

A.4.14 Environmental Restoration Sites

This section is reserved.

A.4.15 Socioeconomics

Table A-35 shows the demographic profile within the Bernalillo County and New Mexico.

Table A-35. Demographic Profile within Bernalillo County and New Mexico, 2022

Parameter	Bernalillo: Number	Bernalillo: % of Total	New Mexico: Number	New Mexico: % of Total
Total Population	674,692	100%	2,112,463	100%
White, non-Hispanic	247,873	36.7%	752,424	35.6%
Black or African American	15,933	2.4%	37,996	1.8%
American Indian and Alaska Native	26,351	3.9%	178,608	8.5%
Asian	17,506	2.6%	32,214	1.5%

Parameter	Bernalillo: Number	Bernalillo: % of Total	New Mexico: Number	New Mexico: % of Total
Native Hawaiian and Other Pacific Islander	378	0.1%	1,117	0.1%
Some other race	3,703	0.5%	7,680	0.4%
Two or more races	20,587	3.1%	50,798	2.4%
Hispanic or Latino	342,361	50.7%	1,051,626	49.8%

Source: USCB 2022.

Figure A-31 through Figure A-35 illustrate the census blocks within Bernalillo County with low-income, under the age of 5, over the age of 64, linguistically isolated, and less than a high school education populations that exceed the average for the state of New Mexico. Figure A-36 illustrates and Pueblo and other tribal lands within Bernalillo County.

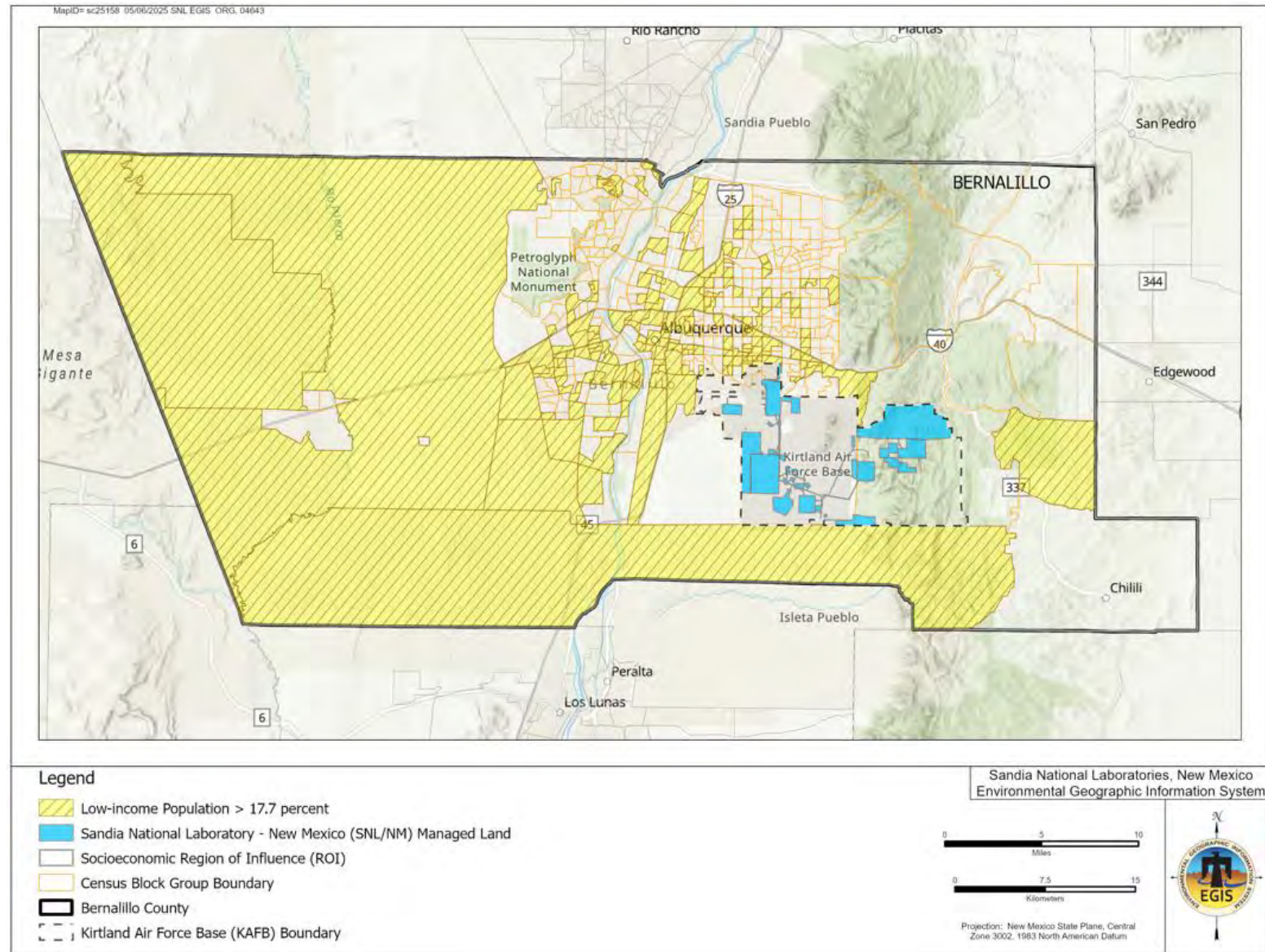


Figure A-31. Low-Income Populations within the ROI

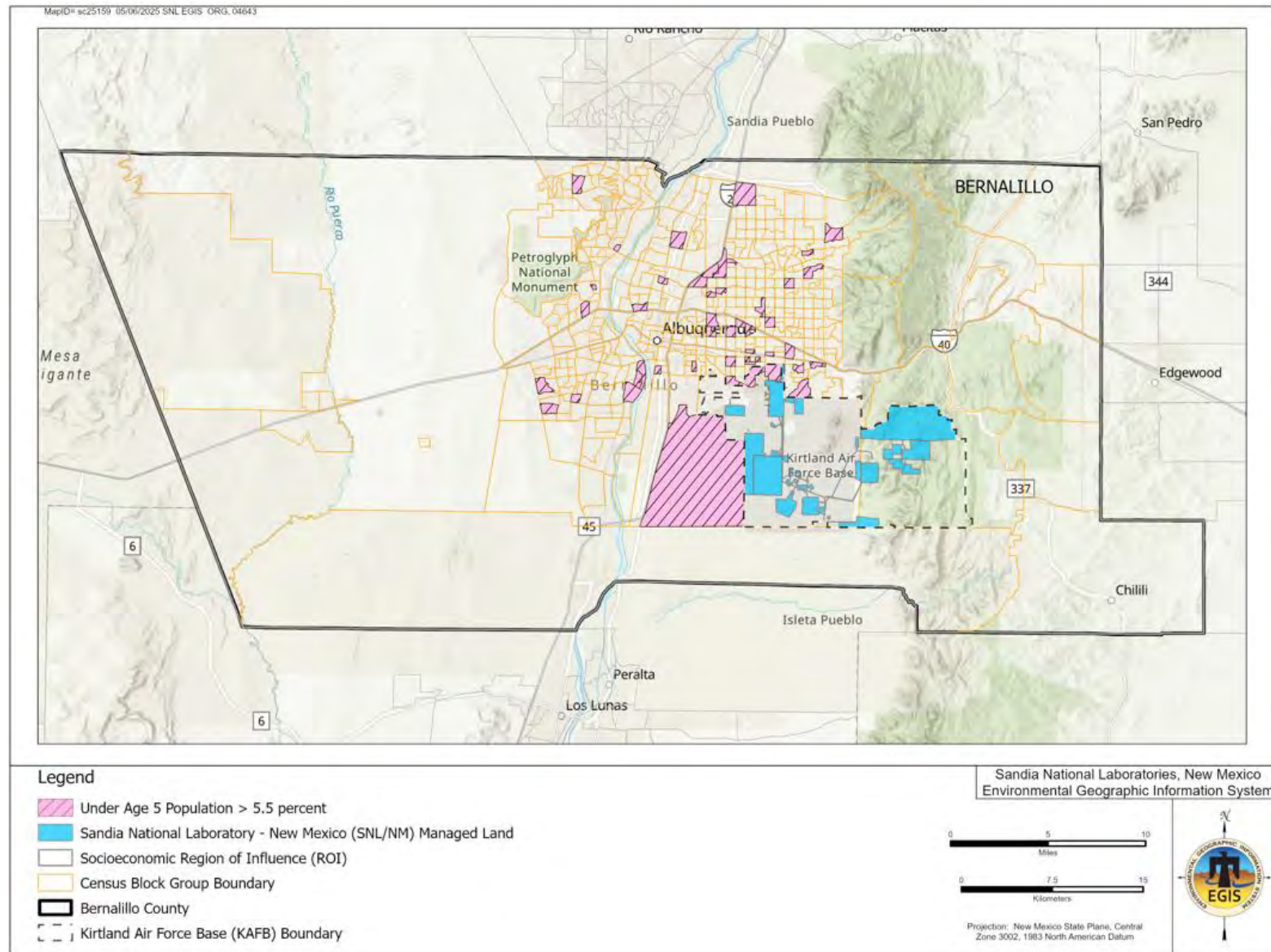


Figure A-32. Under Age 5 Populations within the ROI

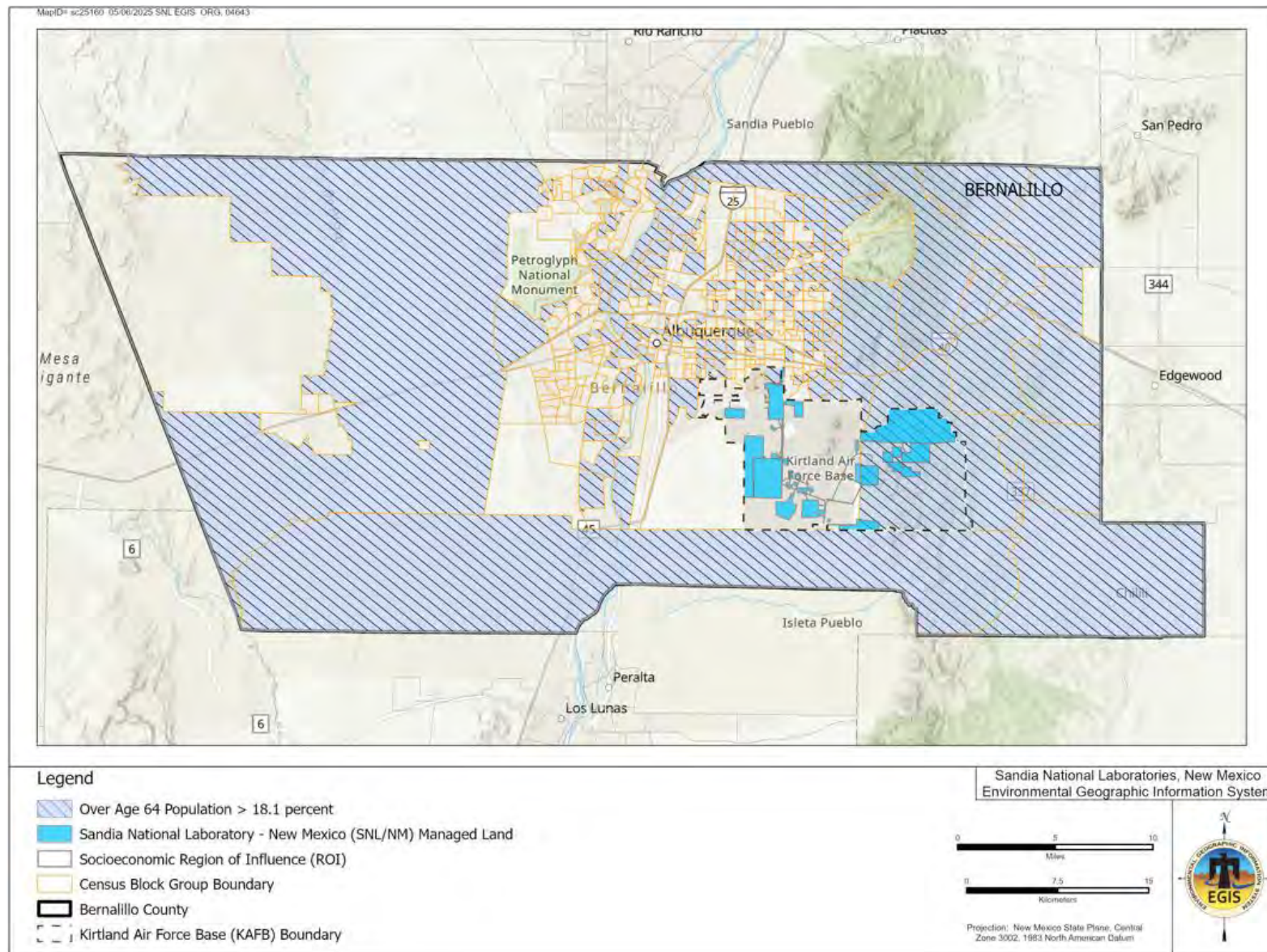


Figure A-33. Over Age 64 Populations within the ROI

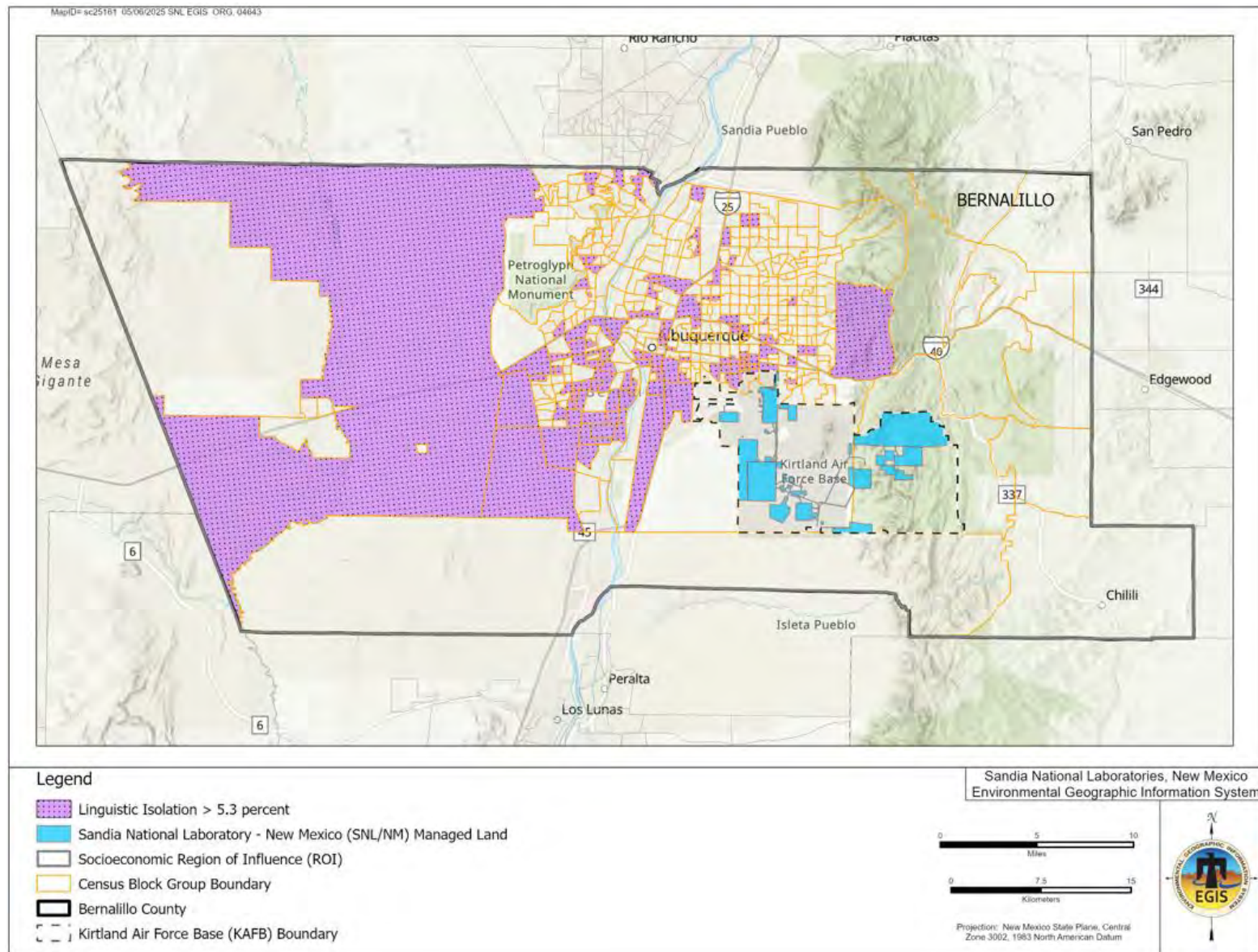


Figure A-34. Linguistically Isolated Populations within the ROI

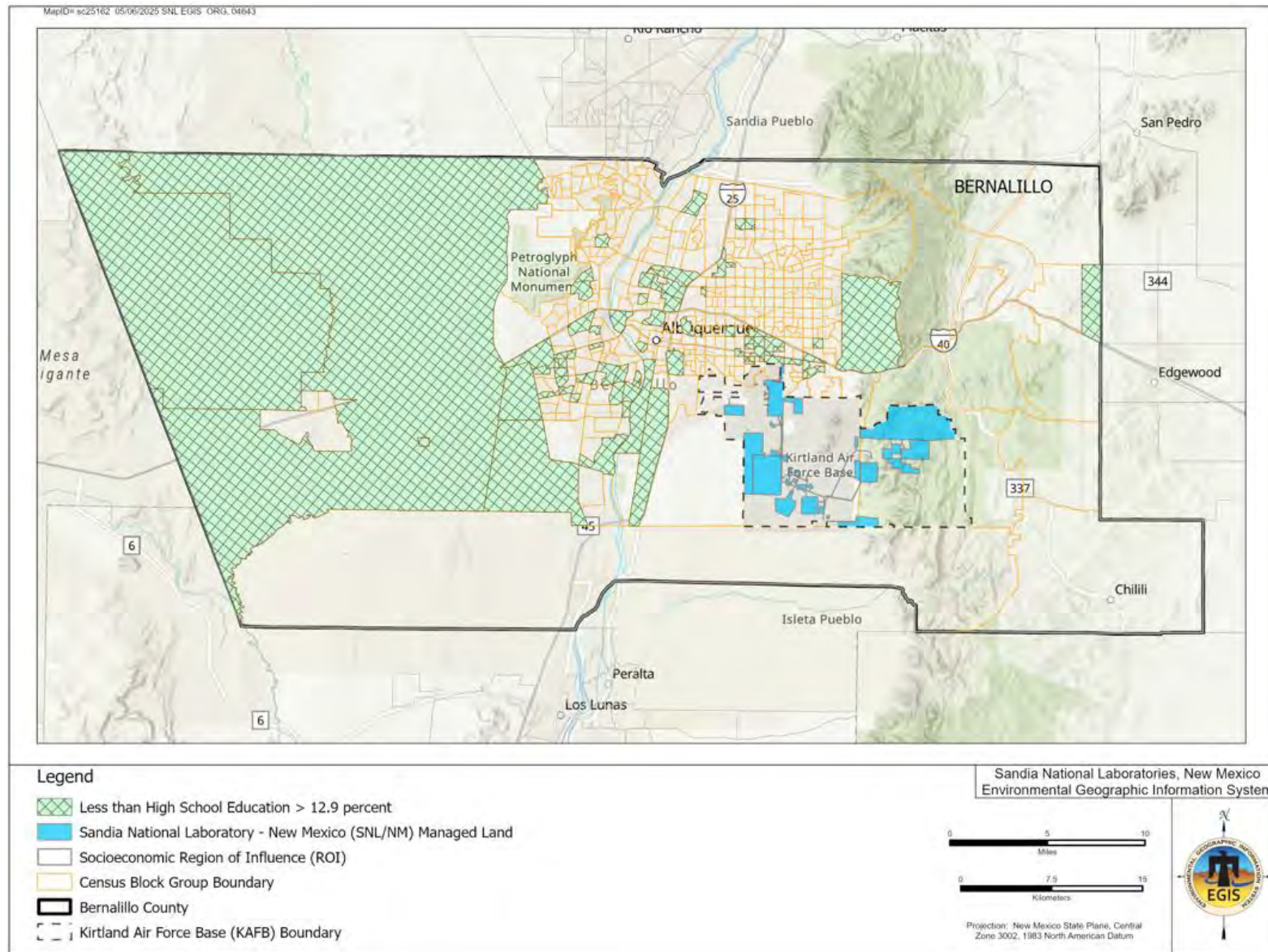
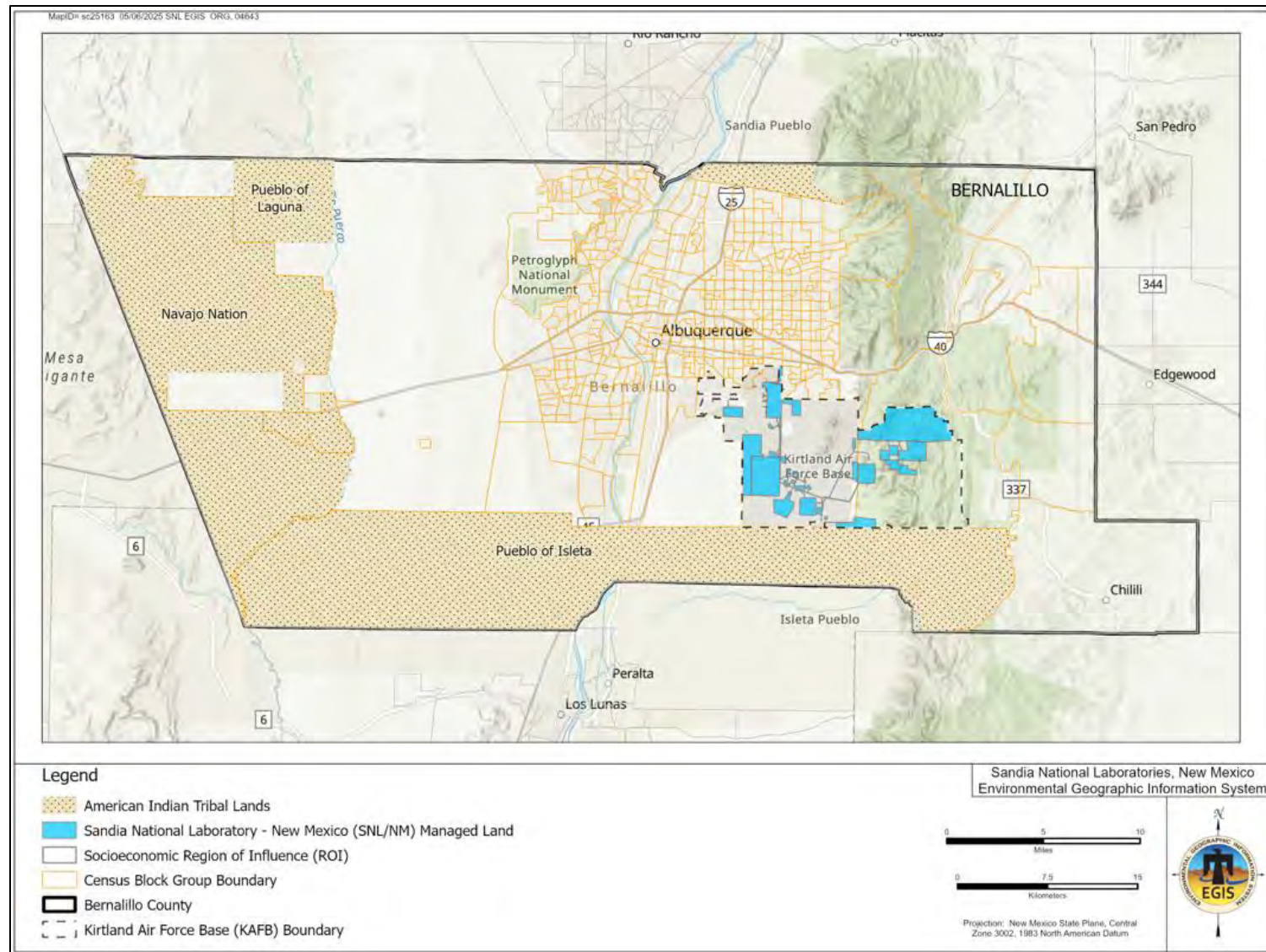


Figure A-35. Populations with Less than High School Education within the ROI



Source: BIA 2024.

Figure A-36. Pueblo and Tribal Lands within the ROI

A.5 ENVIRONMENTAL CONSEQUENCES – SUPPLEMENTAL INFORMATION

This section provides information that supplements and supports the material presented in Chapter 5 of the main document.

A.5.1 Introduction

This section is reserved.

A.5.2 Land Use and Airspace

Table A-36 details the permanent land disturbances for SNL/NM-Managed lands under the no-action alternative by area.

Table A-36. No-Action Alternative Permanent Land Disturbances for SNL/NM-Managed Lands

Existing Environment			No-Action Alternative			
Name of Area	Total Size (acres)	Developed Land Area (acres) ^a	Proposed Development (acres) ^b	DD&D (acres)	Net Developed Land Area (acres)	Percent Change
TA-I	356	317	5.9	2.4	320.5	1.1%
TA-II	256	74	4.6	0	78.6	6.2%
TA-III	1,865	336	0.7	0.3	336.4	0.1%
TA-IV	316	79	1.5	0	80.5	1.9%
TA-V	28	17	0	0	17	no change
KAFB-West & -East	10,922	2,362	0.4	0.1	2,362.3	flat ^b
Eubank	86	65	0	0	65	no change
Totals	13,829	3,250	13.1	2.7	3,260.4	0.3%

a. “Percent Change” is (NAA “Net Developed Land Area” – Existing Environment “Developed Land Area”) / Existing Environment “Developed Land Area” and is shown individually for each area and for the total of all areas.

b. “Flat” signifies a percentage change of less than 1/10th of a percent.

Table A-37 compares the potential facility infrastructure and development density for SNL/NM-Managed lands under the no-action alternative to the existing environment by area.

Table A-37. No-Action Alternative Facility Footprint and Development Density by TA

Existing Environment				No-Action Alternative		
TA	Total Size (acres)	Facility Footprint (ft ²)	Development Density (ft ² /acre)	Facility Footprint (ft ²)	Development Density (ft ² /acre)	Percent Change
I	356	4,361,000	12,250	4,297,328	12,071	-1.5%
II	256	336,000	1,313	494,500	1,932	47.2%
III	1,865	279,000	150	297,500	160	6.6%
IV	316	740,000	2,342	805,400	2,549	8.8%
V	28	208,000	7,429	208,000	7,429	no change
Total	2,821	5,924,000	2,100	6,102,728	2,163	3.0%

- a. Percent change is calculated from the change in square footage. “Percent Change” is (NAA “Facility Footprint” – Existing Environment “Facility Footprint”) / Existing Environment “Facility Footprint.” Percent change is shown individually for each TA and for the total of all TAs.

Table A-38 compares the No-Action Alternative with the permanent changes to the developed land area for SNL/NM-managed lands under the Modernized Operations Alternative.

Table A-38. Modernized Operations Alternative Permanent Land Disturbances (in acres) for SNL/NM-Managed Lands

No-Action Alternative			Modernized Operations Alternative			
Name of Area	Total Size (acres)	Net Developed Land Area (acres)	Proposed Development (acres)	DD&D (acres)	Net Developed Land Area (acres)	Percent Change ^a
TA-I	356	320.5	17.3	9.2	328.6	2.5%
TA-II	256	78.6	13.3	2.6	89.3	13.6%
TA-III	1,865	336.4	4.4	0.2	340.6	1.2%
TA-IV	316	80.5	1.7	0.0	82.2	2.1%
TA-V	28	17	0.0	0.0 ^b	17	flat
KAFB-West & -East	10,922	2,362.3	5.3	0.3	2,367.3	0.2%
Eubank	86	65	0.0	0.0	65	no change
Totals	13,829	3,260.4	42.0	12.4	3,290.0	0.9%

- a. “Percent Change” is (MOD “Net Developed Land Area” – NAA “Net Developed Land Area”) / NAA “Net Developed Land Area.” Percent change is shown individually for each area and for the total of all areas.
- b. TA-V includes 1,000 ft² of DD&D. Due to rounding, the footprint is indicated as 0.0; therefore, percent change is described as flat.

Table A-39 compares the No-Action Alternative with changes to the facility footprint (in square feet) and development density for the five TAs under the Modernized Operations Alternative.

Table A-39. Modernized Operations Alternative Facility Footprint and Development Density by TA

No-Action Alternative				Modernized Operations Alternative		
TA	Total Size (acres)	Facility Footprint (ft ²) ^a	Development Density (ft ² /acre)	Facility Footprint (ft ²)	Development Density (ft ² /acre)	Percent Change ^b
I	356	4,297,328	12,071	4,504,908	12,654	4.8%
II	256	494,500	1,932	915,000	3,574	85.0%
III	1,865	297,500	160	482,000	258	62.0%
IV	316	805,400	2,549	880,400	2,786	9.3%
V	28	208,000	7,429	207,000	7,393	-0.5%
Total	2,821	6,102,728	2,163	6,989,308	2,478	14.5%

- a. “Facility Footprint” includes all permanent facilities. The 40,000-square-foot 20th Street Utility Corridor in TA-I was excluded from calculations because it is not a facility.
- b. Percent change is calculated from the change in facility square footage. “Percent Change” is (MOD “Facility Footprint” – NAA “Facility Footprint”) / NAA “Facility Footprint.” Percent change is shown individually for each TA and for the total of all TAs.

Table A-40 compares the No-Action Alternative with permanent changes to the developed land acreage on SNL/NM-managed lands, accounting for facility construction, utility installations, infrastructure projects, and DD&D actions under the Expanded Operations Alternative.

Table A-40. Expanded Operations Alternative Permanent Land Disturbances (in acres) for SNL/NM-Managed Lands

No-Action Alternative			Expanded Operations Alternative ^a			
Name of Area	Total Size (acres)	Net Developed Land Area (acres)	Proposed Development (acres)	DD&D (acres)	Net Developed Land Area (acres)	Percent Change ^b
TA-I	356	320.5	42.4	13.6	349.4	9.0%
TA-II	256	78.6	52.9	2.6	128.8	63.9%
TA-III	1,865	336.4	6.9	1.5	341.8	1.6%
TA-IV	316	80.5	13.6	5.5	88.7	10.2%
TA-V	28	17	3.4	1.6	18.9	10.9%
KAFB-West & -East	10,922	2,362.3	222.1 ^c	0.6	2,583.8	9.4%
Eubank	86	65	0.7	0	65.7	1.1%
Totals	13,829	3,260.4	342.1	25.3	3,577.2	9.7%

a. Expanded Operations Alternative includes all development under the Modernized Operations Alternative.

b. “Percent Change” is (EXP “Net Developed Land Area” – NAA “Developed Land Area”) / NAA “Developed Land Area.” Percent change is shown individually for each area and for the total of all areas.

c. Does not include up to 1,200 acres for expanded energy projects proposed to be sited on KAFB-managed lands not permitted to NNSA.

Table A-41 compares the No-Action Alternative with changes to the facility footprint (in square feet) and development density for the five TAs under the Expanded Operations Alternative.

Table A-41. Expanded Operations Alternative Facility Footprint and Development Density by TA

No-Action Alternative				Expanded Operations Alternative ^a		
TA	Total Size (acres)	Facility Footprint (ft ²) ^a	Development Density (ft ² /acre)	Facility Footprint (ft ²) ^b	Development Density (ft ² /acre)	Percent Change ^c
I	356	4,297,328	12,071	4,580,608	12,867	6.6%
II	256	527,500	2,061	1,420,000	5,547	187.2%
III	1,865	297,500	160	532,500	286	79.0%
IV	316	805,400	2,549	987,400	3,125	22.6%
V	28	208,000	7,429	289,000	10,321	38.9%
Total	2,821	6,135,728	2,175	7,809,508	2,768	27.3%

a. Expanded Operations Alternative includes all land development under the Modernized Operations Alternative.

b. “Facility Footprint” includes all permanent facilities. These figures do not include 1,441 acres of site-wide expanded energy infrastructure, 20 acres of infrastructure lines and roads in TA-II, and 3.3 acres of fencing in KAFB-East because these are not facilities.

c. Percent change is calculated from the change in facility footprint (ft²). “Percent Change” is (EXP “Facility Footprint” – NAA “Facility Footprint”) / NAA “Facility Footprint.” Percent change is shown individually for each TA and for the total of all TAs.

A.5.3 Visual Resources

NNSA is considering a PV + CSP project with both battery and thermal storage technologies at either Site B or C, as shown in Figure A-37. Visual impacts would occur at either Site B or C from the concentrated light reflected from the heliostats and receiver, and from light reflected from the glass cover of the PV modules. Figure A-37 shows the two potential site locations and key observation points.

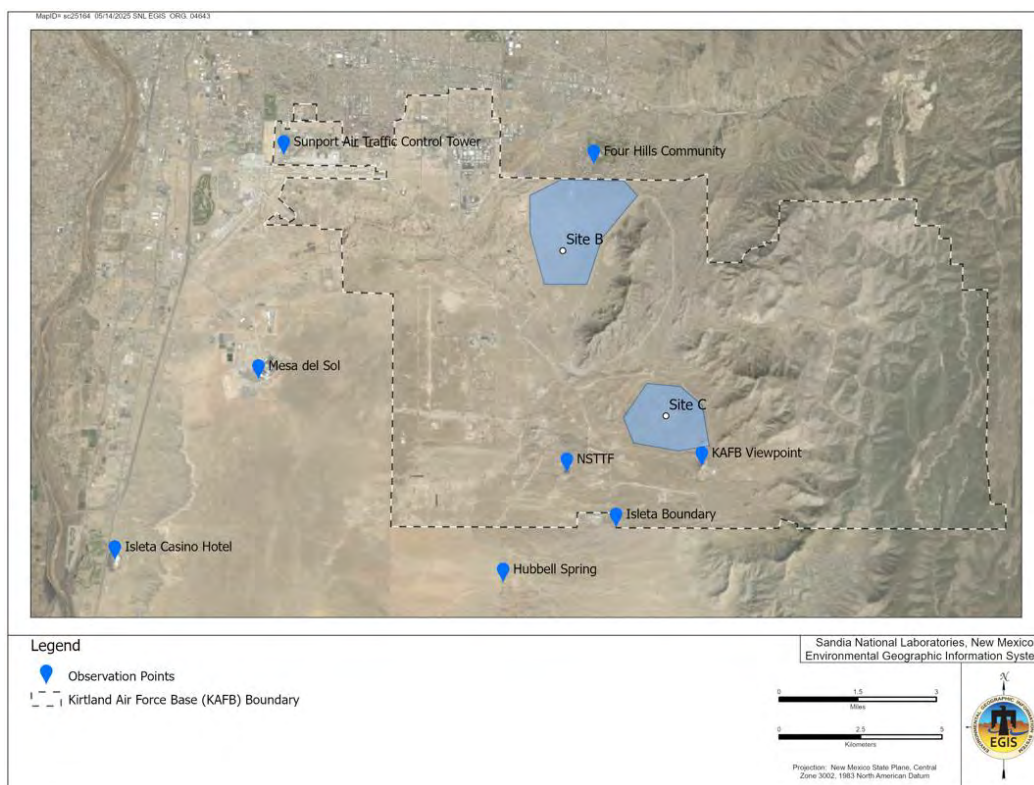


Figure A-37. Site B and Site C with Observation Points Shown

Figure A-38 provides a ground-level view of a representative CSP facility (Ivanpah) in Nevada (ANL 2015), showing major facility components, at a 9-mile distance to the tower at center. Figure A-39 shows the fully illuminated receiver on the Ivanpah CSP Tower, which is about 450 feet in height compared to the 400-foot maximum height of the tower for the CSP component of the project at KAFB-West. The CSP component of the project at KAFB-West would introduce a new vertical element into the landscape. The tower's bulk and mass could alter the visual balance of the landscape and, depending on the color and materials used, the tower may reflect sunlight, causing glare or visual disturbances and contrasting with the surrounding environment. Reflected sunlight from the tower receiver and heliostats would be the primary source of visual contrast from the CSP elements of the proposed project under sunny conditions. The significance of these reflections would depend on several factors, including viewing distance, angle, and potential mitigation measures implemented by the facility.

(e.g., siting, geometric configuration of the receiver, heliostat operation, material/color selection, shielding) (ANL 2015 and Ho et al. 2018).

Depending on the viewer's location, reflected sunlight from the receiver could be bright and sometimes difficult to look at, especially at short distances from the facility (refer to Figure A-39) ANL (2015) reported that concentrated sunlight reflected from the tower receiver at the representative Ivanpah PV + CSP facility in Nevada could be difficult to view directly at distances up to 4 miles. However, NNSA notes that another study of the visual impacts of a PV + CSP plant (Crescent Dunes, also in Nevada) concluded that "reflected sunlight from the receiver rarely caused discomfort for observers, regardless of distance" (ANL 2017).

The elevation of the viewer relative to the proposed CSP tower would have a notable effect on the perceived visual impacts and the project would generally be visible from longer distances for viewers at higher elevation. Figure A-40 shows a representative PV + CSP facility from an elevated viewpoint at a distance of 4.8 miles to the tower. In unobstructed views, the proposed CSP element of the project is expected to be a major source of visual contrast up to 20 miles and could be visible at 35 miles based on descriptions of the representative Ivanpah PV + CSP project in Nevada (ANL 2015). Glare from individual heliostats that are not aiming properly ("rogue heliostats") can reflect light that appears brighter than the reflected light from the tower receiver, even at 35 miles as shown in Figure A-41. Typically, glare from individual rogue heliostats can be visible for only a few seconds but occasionally can last for a few minutes (ANL 2015).

Figure A-42 shows views of another reference commercial CSP facility (PS-10) near Seville, Spain. The PS-10 PV + CSP facility in Spain has a 377-foot-tall tower and produces about 11 megawatts (MW) of electricity. Unlike the Ivanpah and Crescent Dunes PV + CSP facilities in Nevada, the PS-10 PV + CSP facility implements a directional south-facing heliostat field (versus a surround heliostat field used by Ivanpah and Crescent Dunes). In the northern hemisphere, the mirrors of a directional heliostat field would face predominantly southward throughout the day, and concentrated sunlight reflected from the tower receiver would be directed predominantly northward. The proposed CSP element of the project at KAFB-West would likely implement a directional heliostat field, which would help mitigate receiver glare toward Pueblo of Isleta lands and DAF operations.



Source: ANL 2015.

Figure A-38. Unobstructed Ground-level View of Representative Ivanpah PV + CSP Facility at 9-mile Distance to Tower



Source: ANL 2015.

Figure A-39. Fully Illuminated Receiver on Ivanpah CSP Tower



Source: ANL 2015.

Figure A-40. Unobstructed View of Representative Ivanpah PV + CSP Facility from Elevated Viewpoint at 4.8-mile Distance to Tower



Source: ANL 2015.

Figure A-41. Unobstructed View of Representative Ivanpah PV + CSP Facility at 35-mile Distance to Tower. Reflections from two “rogue” heliostats are visible



Source: Wikipedia (https://en.wikipedia.org/wiki/PS10_solar_power_plant)

Figure A-42. Two Views of a Representative PV + CSP Solar Tower near Seville, Spain (PS-10), Which Has a Directional South-Facing (vs. Surround) Heliostat Field

In addition to the two site alternatives, there are design alternatives for the PV + CSP project, namely related to tower height (200 feet and 400 feet) and receiver configurations (north-facing and surround). The visual impacts of both the 200-foot and 400-foot towers were evaluated, and potential visual hazards from viewing glare from the receiver were found to be nearly identical for the two heights.

A directional (north-facing in the northern hemisphere) receiver can take advantage of greater optical efficiency of a directional heliostat field but may require greater land use or more restrictive geometries relative to a surround-field system to achieve the same power. Table A-42 summarizes the design scenarios of the PV + CSP project evaluated for visual impacts, along with key observation points. Figure A-43 provides images of both a directional (north-facing) CSP system (PS-10 in Spain) and a surround-field CSP system (Gemasolar in Spain).

Table A-42. PV + CSP Project Design Scenarios for Visual Impact Analyses

Location of Tower	Receiver/Configuration	Key Observation Points
CSP at Site B	North Facing	1. Four Hills 2. KAFB Viewpoint 3. Pueblo of Isleta Boundary 4. Hubbell Spring 5. Isleta Casino 6. Mesa del Sol 7. Sunport Air Traffic Control Tower
	Surround	
CSP at Site C	North Facing	
	Surround	



Source: CABQ 2023.

Figure A-43. Directional CSP System (PS-10) and Surround-Field CSP system (Gemasolar)

For a PV system, two design systems are evaluated: fixed tilt and single-axis tracking. A fixed-tilt mounting system is stationary, and the PV modules are tilted at a prescribed angle, typically to maximize energy production. A single-axis tracking system rotates the modules about a single axis (typically aligned in the north-south direction) and follows the location of the sun throughout the day.²⁵ Table A-43 summarizes the PV design scenarios evaluated for visual impacts, along with key observation points.

The following sections outline the impacts to visual resources from implementation of the proposed PV + CSP project related to two key concerns: (1) the potential for glare, which could cause temporary visual discomfort or hazards to observers in the surrounding area, and (2) the potential for after-image,²⁶ a phenomenon that may result in lingering visual impressions following exposure to intense light sources.

²⁵ Two-axis tracking systems, which continuously orient PV modules directly toward the sun, are available. However, due to their higher installation and maintenance costs, these systems were excluded from the scope of analysis.

²⁶ After-image is the impression that lingers in the visual field after exposure to a bright light source. It occurs when the retina, particularly the photoreceptor cells, becomes overstimulated by intense illumination. This overstimulation temporarily desensitizes the affected photoreceptors, creating a “ghost” image or pattern that persists even after the light source is no longer in view. The intensity and duration of the after-image are influenced by factors such as the brightness of the light source, the duration of exposure, and the viewer’s adaptive state to surrounding light levels.

Table A-43. PV Design Scenarios for Visual Impact Analyses

Location	Mounting	Key Observation Points
PV at Site B	Fixed tilt	1. Four Hills 2. KAFB Viewpoint 3. Pueblo of Isleta Boundary 4. Hubbell Spring 5. Isleta Casino 6. Mesa del Sol 7. Sunport Air Traffic Control Tower
	Single-axis tracking	
PV at Site C	Fixed tilt	
	Single-axis tracking	

A.5.3.1 Impacts from the Concentrating Solar Power Tower

A glare analysis was performed to evaluate potential visual impacts from viewing concentrated sunlight reflections for the different receiver configurations listed in Table A-43. First, renderings of the different CSP configurations were developed to determine whether glare from the CSP receiver on top of the tower could be seen from the key observation points shown in Figure A-37. Figure A-44 through Figure A-46 show renderings from views at three key locations.

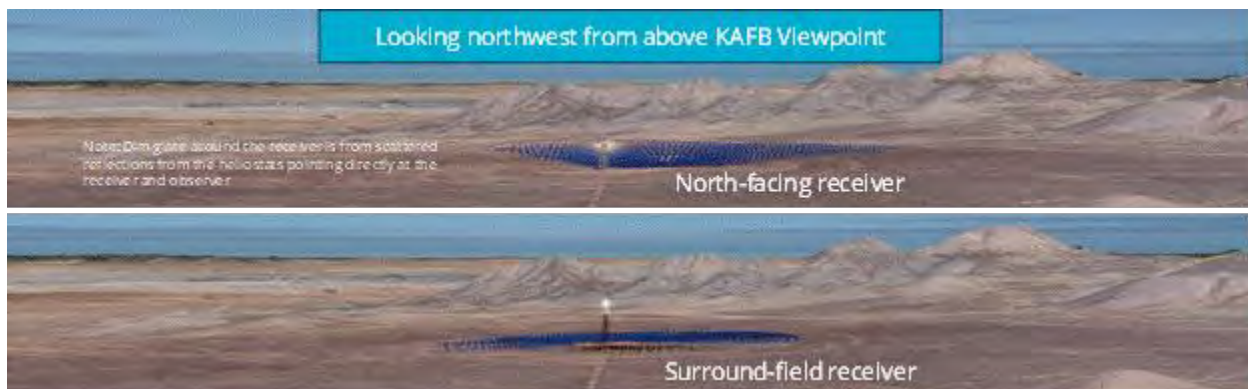


Figure A-44. Rendering of CSP Configurations (North Facing and Surround) at Site C as Viewed from KAFB Viewpoint

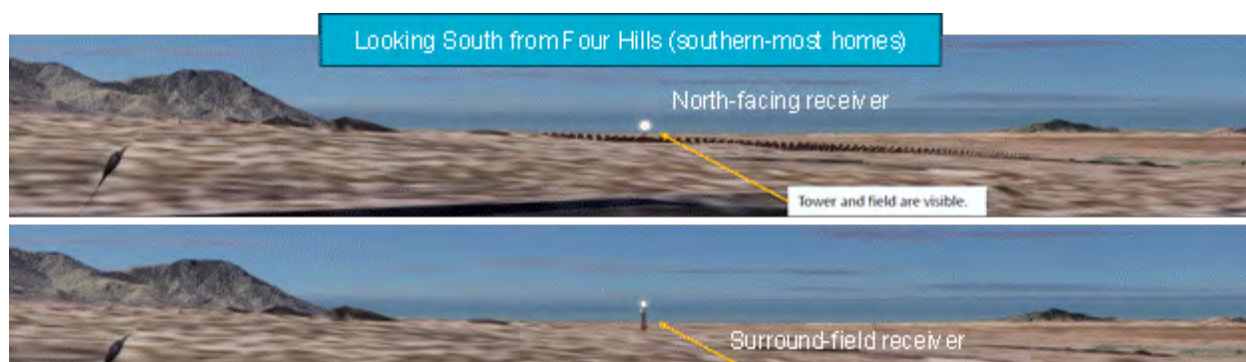


Figure A-45. Rendering of CSP Configurations (North Facing and Surround) at Site B as Viewed from the Southern Border of Four Hills Community

For a north-facing receiver, observation points to the south of the tower will not be able to see glare reflecting off the receiver. For a surround-field receiver, glare can be viewed all around the receiver as long as it is not obstructed by natural terrain or the built environment, which is considered in the renderings shown in Figure A-44 through Figure A-46. Note that in Figure A-45, the view is from the southern border of the Four Hills community. Views from within the community may be partially or fully obstructed by the built environment, vegetation, and/or topography.



Figure A-46. Rendering of CSP Configurations (North Facing and Surround) at Site B as Viewed from the Albuquerque Sunport Air Traffic Control Tower

A visual impact analysis was also performed for locations where glare was visible using the method published by Ho et al. (2011). All of the locations where glare would be visible yielded a low potential for after-image. Table A-44 summarizes the glare analysis results for all receiver configurations and locations evaluated.

Table A-44. Summary of CSP Receiver Glare from Key Observation Points

Location of Tower	Receiver Design	KAFB Viewpoint	Four Hills	Mesa del Sol	Pueblo of Isleta (Boundary)	Pueblo of Isleta (Casino)	Pueblo of Isleta (Hubbell Spring)	Sunport Air Traffic Control Tower
Site B	North Facing	None	Visible	None	None	None	None	Visible
	Surround	None	Visible	Visible	Visible	None	Visible	Visible
Site C	North Facing	None	None	Visible	None	None	None	Visible
	Surround	Visible	None	Visible	Visible	None	Visible	Visible

Note: At all locations where glare was visible, the visual impact was deemed to have a low potential for after-image.

A viewshed analysis was conducted utilizing a Digital Elevation Model (DEM) to evaluate potential visual impacts from specific observation points. The DEM involved simulating tower elevations of 200 and 400 feet at Sites B and C, to map areas with direct lines of sight to the proposed CSP tower. This approach was designed to represent a worst-case visual scenario, focusing exclusively on the influence of the area's topography while deliberately excluding other variables such as vegetation, built structures, infrastructure, and atmospheric conditions. Consequently, the DEM highlights locations from where unobstructed views may occur based purely on elevation and landform, though it is acknowledged that many of these identified viewpoints may, in reality, be obstructed by non-topographical elements. This methodology provides a preliminary baseline for assessing potential visual impacts.

Figure A-47 through Figure A-50 provide viewshed maps of the 200-foot and 400-foot CSP towers at both Site B and Site C. The viewshed map shows regions where the CSP tower would be visible. These areas are dispersed and generally follow elevated terrains or regions with clear sightlines to the tower, highlighting the impact of topography and obstructions on visibility. The sightlines to the 200-foot CSP towers are generally more constrained than those of the 400-foot towers. The visibility pattern suggests that significant portions of the surrounding area may not have direct views of the tower, particularly in valleys or areas with intervening natural or man-made structures.

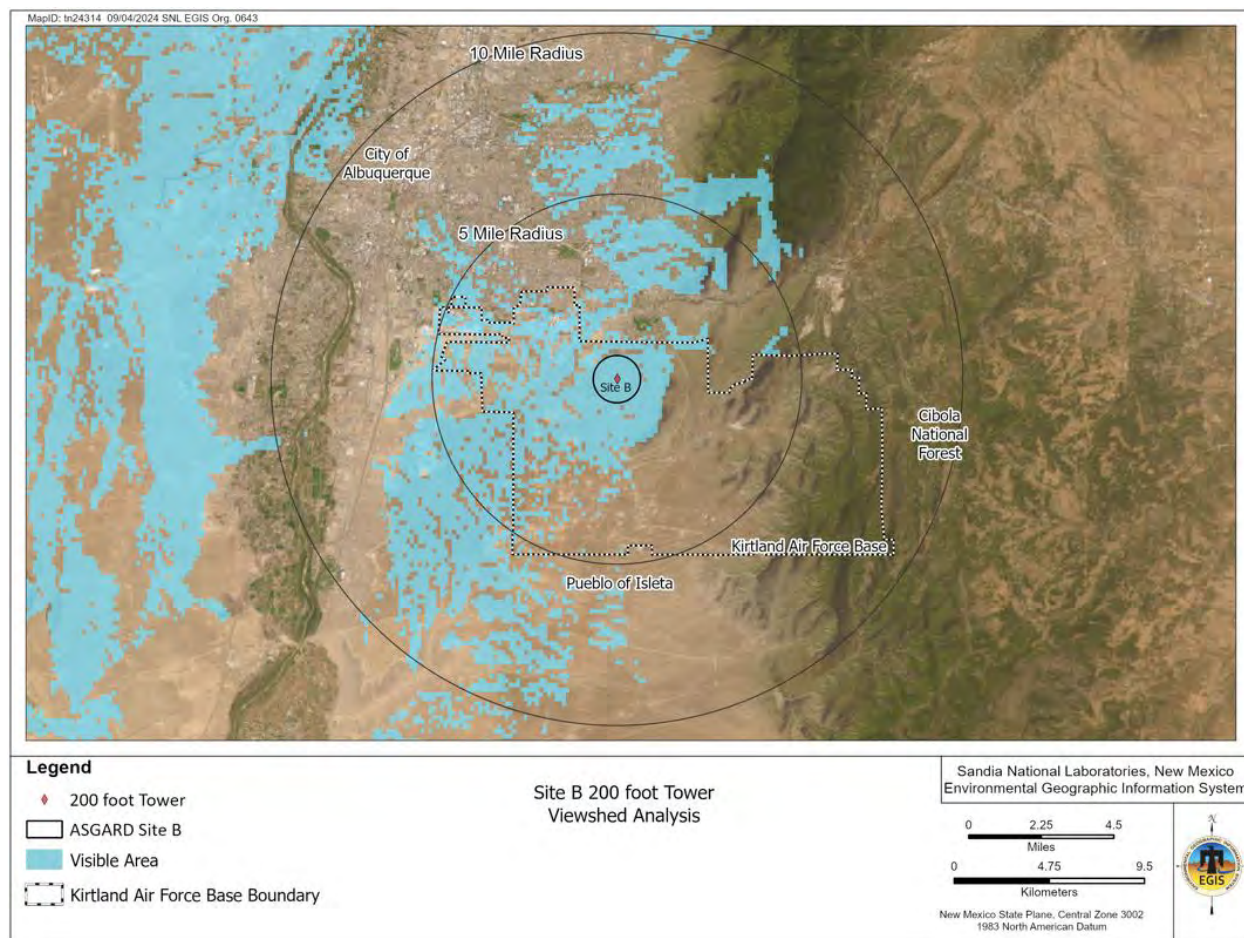


Figure A-47. Viewshed Map of 200-Foot CSP Tower at Site B

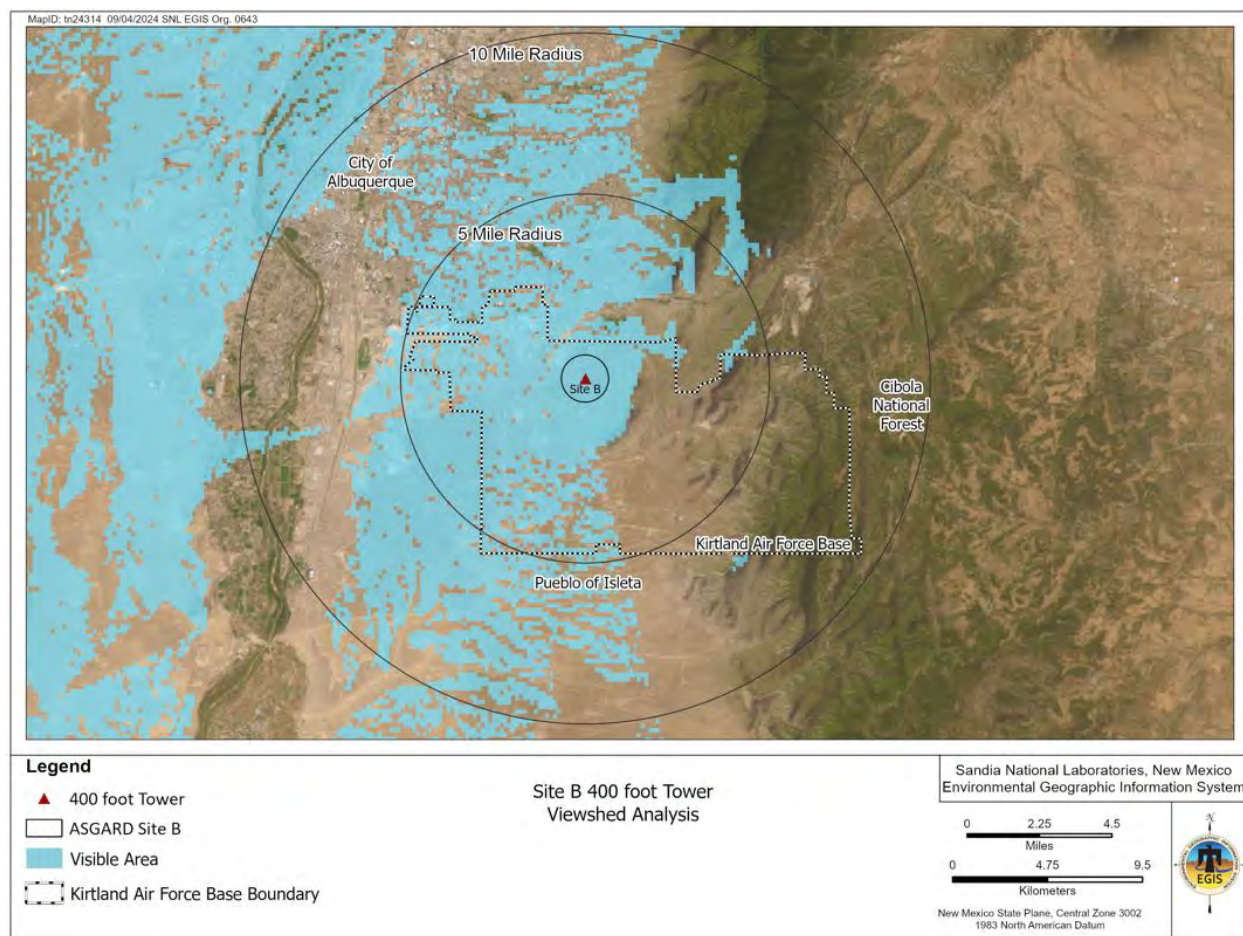


Figure A-48. Viewshed Map of 400-Foot CSP Tower at Site B

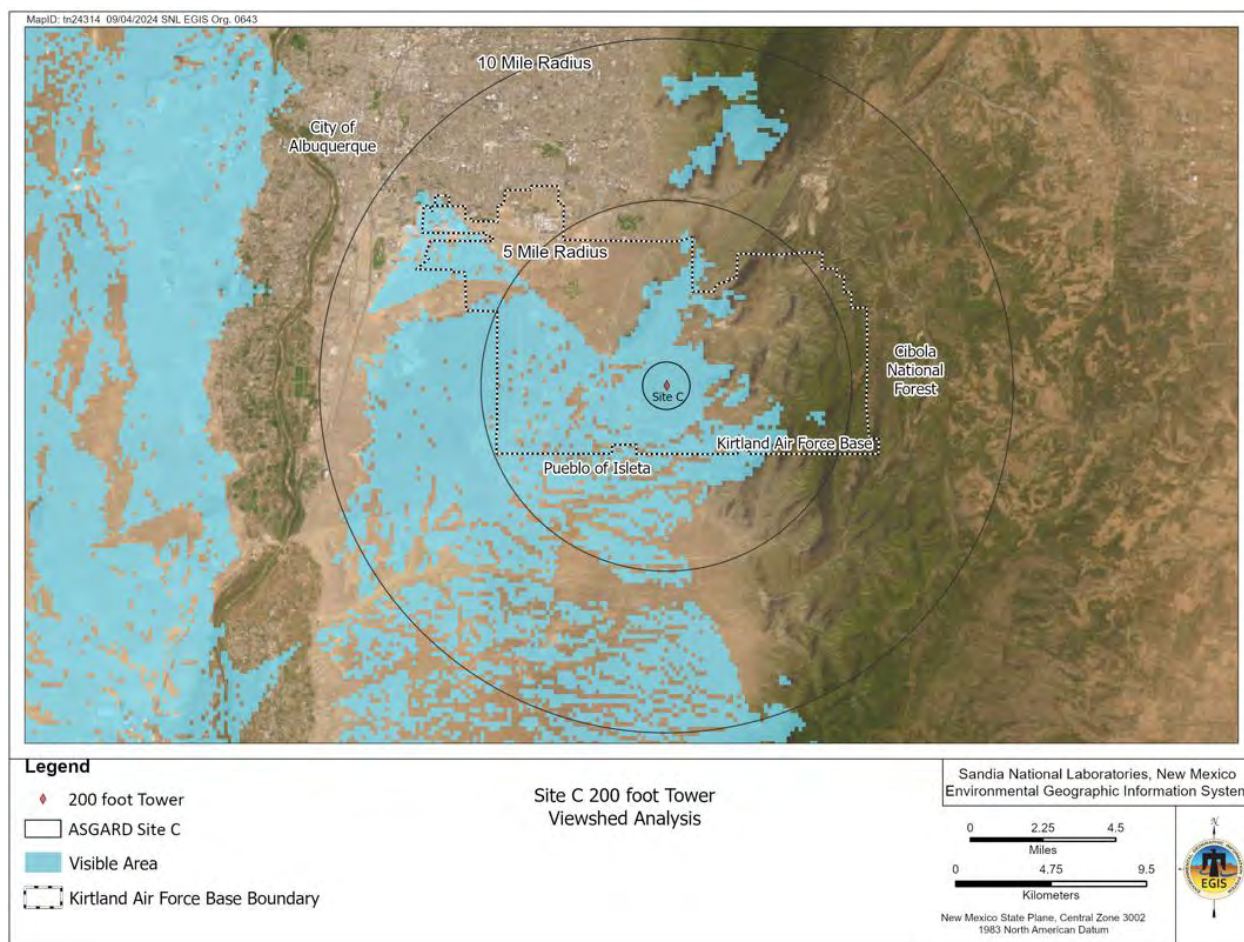


Figure A-49. Viewshed Map of 200-Foot CSP Tower at Site C

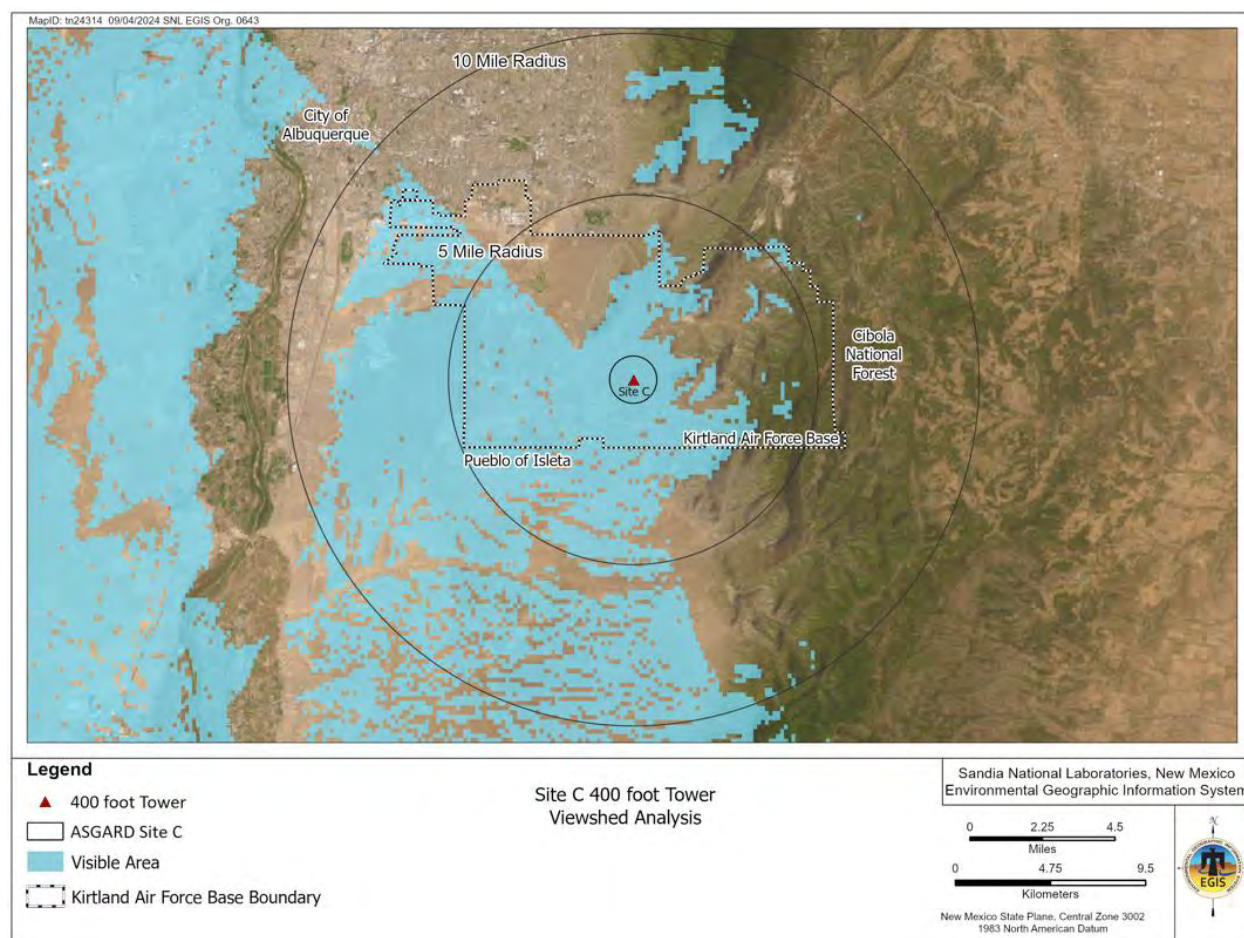


Figure A-50. Viewshed Map of 400-Foot CSP Tower at Site C

A.5.3.2 Impacts from Solar Photovoltaic Arrays

The commercial online software tool, ForgeSolar, was used to evaluate glare impacts from PV systems at Sites B and C.²⁷ Figure A-51 shows the results of the ForgeSolar glare analysis for a fixed-tilt (30°) PV array located on Site B. The entire region of Site B was assumed to be occupied by PV modules as a worst-case scenario. Figure A-51 shows the locations from where glare would be visible, the times throughout the year when glare would be visible, and the visual impact. For a fixed-tilt (30°) PV array located at Site B, and for the key observation points shown in Figure A-37, glare would only be visible from Mesa del Sol for up to an hour during

²⁷ ForgeSolar is based on SNL-developed technology and was validated using field data from several commercial sites (Ho et al. 2015 and Ho and Sims 2014). The tool predicts glare and visual impacts for PV arrays throughout the year and can be used to design systems that optimize energy production while mitigating glare. ForgeSolar uses the interactive Google Maps to locate a prospective site, design the PV array (areal extent, tilt, azimuth), and identify key observation locations or paths.

the morning in the summer months. Most of the time, the glare would yield a low potential for after-image, but during some periods, potential for after-image exists.

Figure A-52 shows a similar glare analysis for a fixed-tilt (30°) PV array located on Site C. The entire region of Site C was assumed to be occupied by PV modules. Figure A-52 shows the locations from where glare would be visible, the times throughout the year when glare would be visible, and the visual impact. For a fixed-tilt (30°) PV array located at Site C, and for the key observation points shown in Figure A-37, glare would only be visible from the KAFB Viewpoint for up to an hour during the late afternoon in the summer months. Most of the time, the glare would yield a low-potential for after-image, but during some periods, potential for after-image exists.

If single-axis tracking about a horizontal north-south axis is used, glare is eliminated from all of the key observation locations shown in Figure A-37. Single-axis tracking tends to increase the operational efficiency of the PV modules while mitigating glare impacts. Figure A-53 illustrates the operation of a single-axis tracking system.

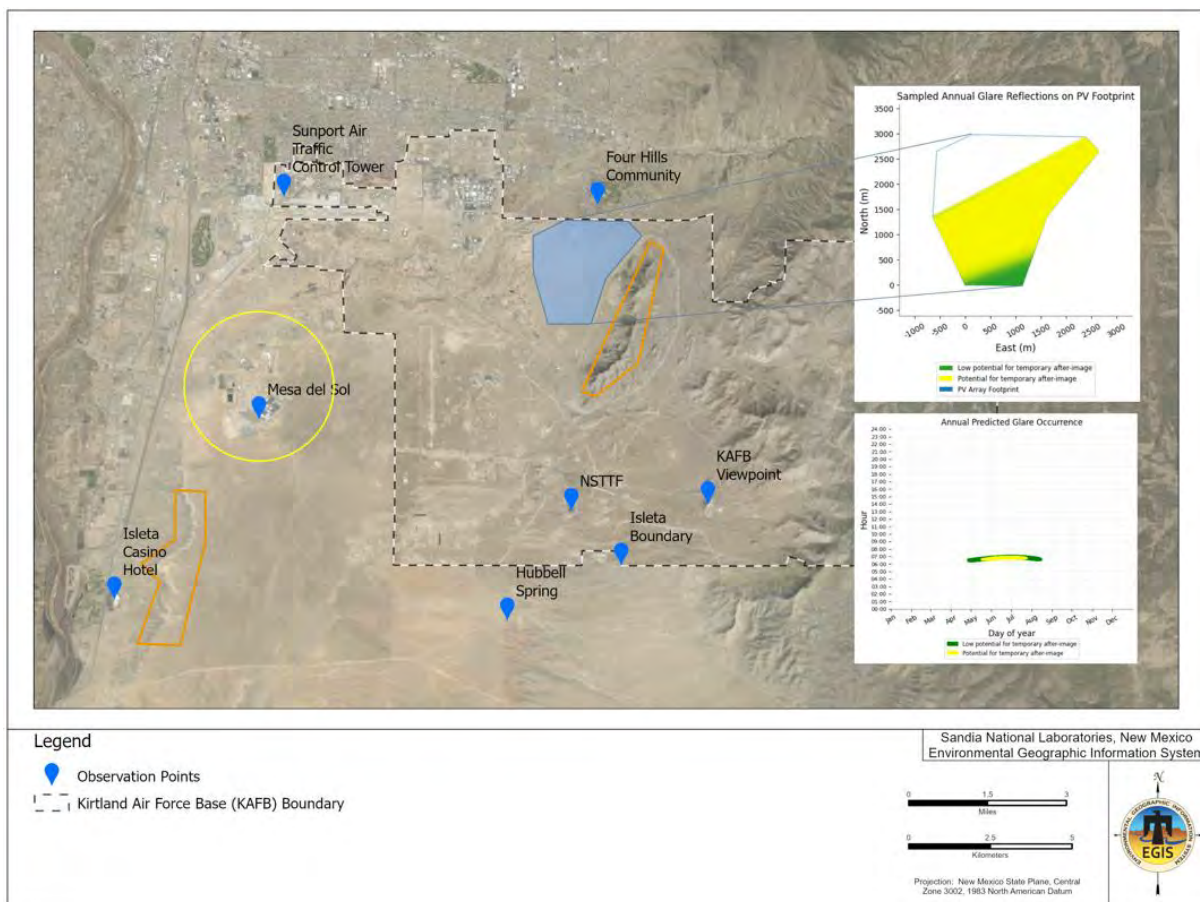


Figure A-51. Glare Analysis for PV Array Sited Within Site B and Annual Predicted Glare Occurrence from Mesa Del Sol

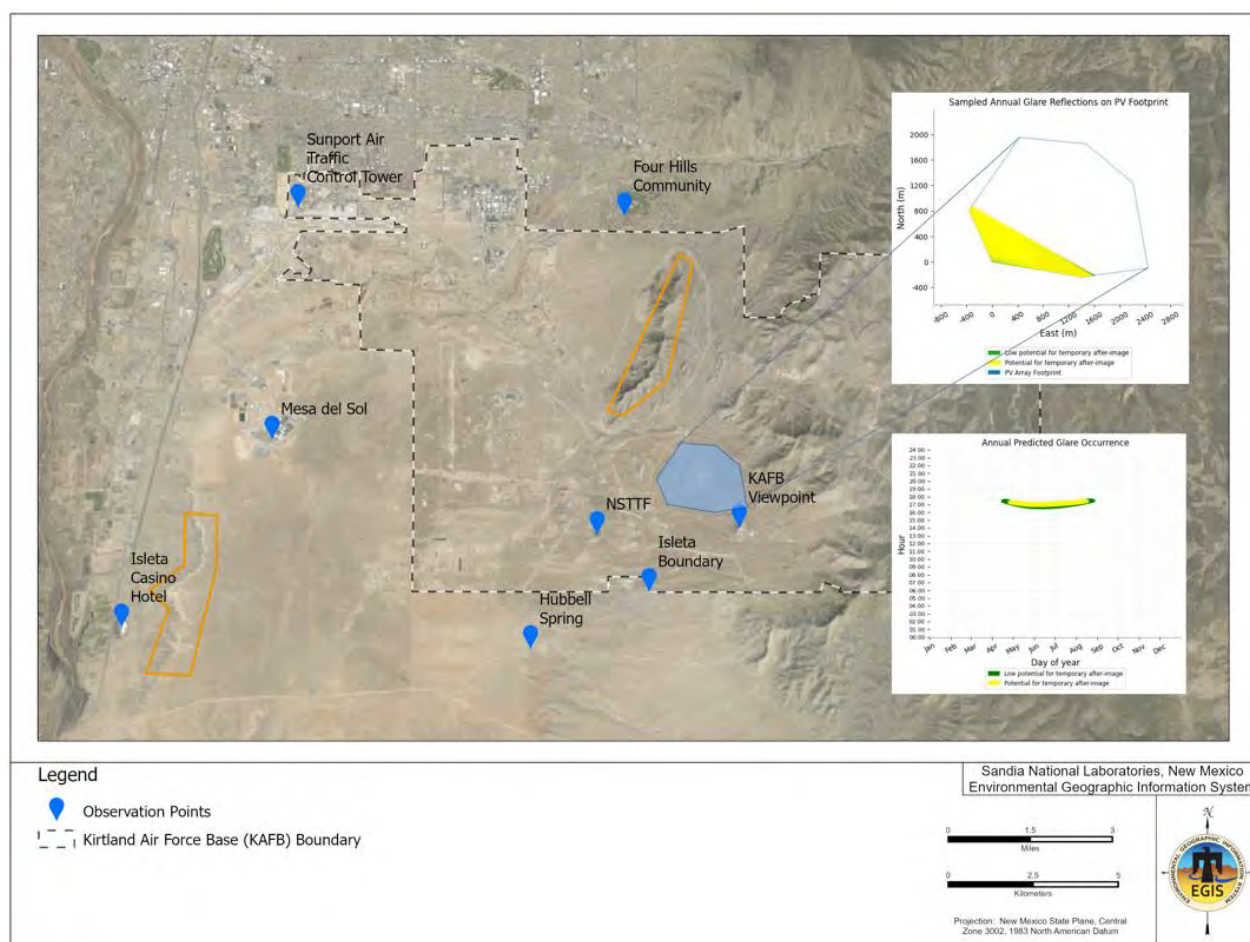


Figure A-52. Glare Analysis for PV Array Sited Within Site C and Annual Predicted Glare Occurrence from KAFB Viewpoint

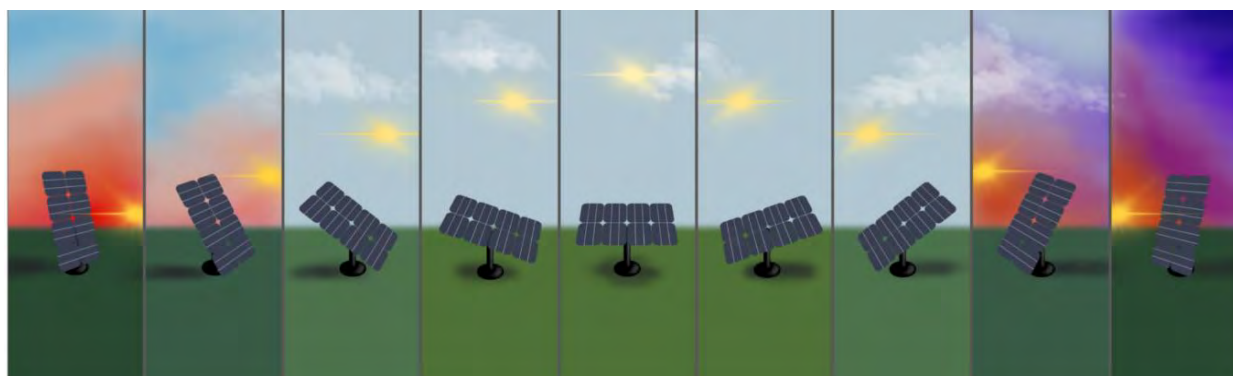


Figure A-53. Illustration of Single-Axis Tracking (ForgeSolar)

Due to concerns with potential glare impacts from a PV system at Site C, a glare analysis was also performed to determine the potential impacts of a fixed-tilt (30°) PV array on flight

operations at the Albuquerque Sunport and KAFB. Figure A-54 shows the relevant flight paths that were considered.

Table A-45 summarizes the results. Only the drop zone path is impacted by glare with some potential for after-image. Single-axis tracking mitigates glare at all locations.²⁸

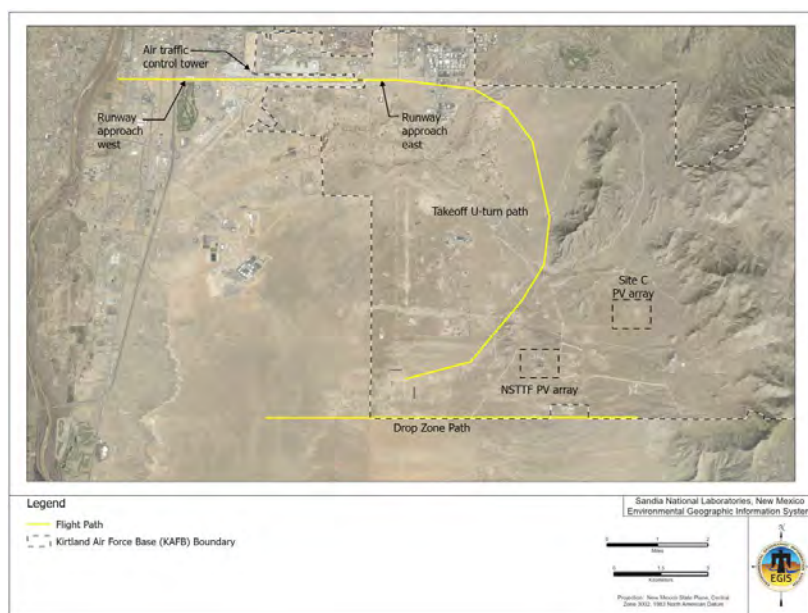


Figure A-54. Flight Path Glare Analysis from PV Array at Site C and NSTTF – Relevant Flight Paths

Table A-45. Summary of Glare Analysis and Potential Impacts of PV Arrays at the NSTTF and Site C on Flight Operations near KAFB

Location/Configuration	Control Tower	Runway Approach Paths	Take-Off U-Turn Path	Drop Zone Path
NSTTF PV Panels – 30° fixed tilt	None	None	None	Low potential for after-image
Site C PV Panels – 30° fixed tilt	None	None	None	Potential for after-image
Single-Axis Tracking	None	None	None	None

²⁸ It should be noted that FAA has determined that solar glare from PV modules is similar to other reflective flat surfaces like glass windows and water bodies commonly experienced by pilots and is therefore manageable (14 CFR Part 77). However, glare to the air traffic control tower must not cause a visual impact.

A.5.4 Geology and Soils

This section is reserved.

A.5.5 Water Resources and Hydrology

This section is reserved.

A.5.6 Air Quality

This section is reserved.

A.5.7 Noise

This section is reserved.

A.5.8 Biological Resources

In their evaluation using multi-scalar contextualization of existing avian mortality at utility-scale solar energy facilities in Southern California, Walston et al. (2016) found avian mortalities were considerably lower than most other human activities (refer to Table A-22).

Ho (2016) studied risks to birds from solar flux or sunlight intensity at various CSP plants. This study indicated that leading causes of avian species deaths at CSP plants are from collisions (primarily with reflective surfaces; i.e., heliostats) and singeing caused by exposure to concentrated solar flux. At the Ivanpah PV + CSP plant in California, the levelized avian mortality rate during the first year of operation before mitigation measures were implemented was estimated to be 0.7–3.5 fatalities per gigawatt hour (GWh), which was less than the levelized avian mortality reported for fossil fuel plants but greater than that for nuclear and wind power plants (Ho 2016). Walston et al. (2016) produced estimates that include mortalities of unknown causes, observer bias, and scavenger probabilities at existing CSP facilities and estimated bird mortalities of 3.55–4.08 birds/GWh/year across all types of industrial scale solar facilities (PV and CSP). Smallwood (2022) predicted higher rates of mortality due to previous studies' insufficient monitoring (mortalities per MW/year of 11.61 birds and 0.06 bats at PV projects and 64.61 birds and 5.49 bats at CSP) across multiple sites. At the SNL/NM NSTTF CSP facility (near Site C where proposed expanded energy projects would be built) there has been little to no evidence of CSP-induced avian mortality; however, this small-scale test facility operates infrequently (Baumann 2025). The proposed expanded energy project at Site C would have a larger heliostat field and would operate more frequently.

Studies also show that potential avian mortality would depend on facility design and could be reduced through use of deterrents to keep birds away and heliostat aiming strategies that reduce solar flux during standby (Ho et al. 2018; Ho 2016; Kraemer 2015), but the most effective strategies may decrease annual energy output (Ho et al. 2018). Safe irradiance levels for birds have been reported to range between 4 and 50 kilowatts per square meter (kW/m²); above these levels, singeing and irreversible feather damage can occur (Ho 2016). In modeling vaporization potential for birds (meaning that carcass searches would be less effective in measuring mortality

rates), the study (Ho 2016) predicted that complete vaporization of birds was unlikely, but this theory has not been tested. Uncertainty surrounding impacts at Sites B and C points to the importance of implementing a Bird and Bat Conservation Strategy (BBCS) at SNL/NM, especially as impacts of deterrents and heliostat aiming strategies have not been well-studied and mortality estimates have a wide range depending on various circumstances (Walston et al. 2016).

A.5.9 Cultural Resources

This section is reserved.

A.5.10 Traffic and Transportation

Table A-46 estimates the impacts from transporting radioactive materials and wastes over each transportation segment within each alternative's proposed 15-year duration. These values were used to develop the total values in Chapter 5, Section 5.10.

Table A-46. Estimated Impacts of Transporting Radioactive Materials and Wastes over Each Alternative's Proposed 15-Year Duration

Alternative/ Transport Segments	Offsite Destination or Origination	Radiological Material (estimated peak number of shipments)	Segment Distance	Incident-Free ^a Crew Total Dose (person-rem)	Incident-Free ^a Crew Total Risk (LCFs)	Incident-Free ^a Population Total Dose (person-rem)	Incident-Free ^a Population Total Risk (LCFs)	Accident ^a Annualized Radiological Risk (LCFs/yr)	Accident ^a Non-Radiological Risk (# of traffic-accident fatalities/yr)
<i>No-Action – 15 years of shipping</i> SNL/NM to/from LANL	LANL	SNM (128)	100	0.039	2.3×10^{-5}	0.044	2.6×10^{-5}	2.7×10^{-10}	$1.1 \times 10^{-5}{}^b$
<i>No-Action – 15 years of shipping</i> SNL/NM to/from LLNL	LLNL	SNM (45)	1,050	0.14	8.4×10^{-5}	0.16	9.5×10^{-5}	9.6×10^{-10}	$3.9 \times 10^{-5}{}^b$
<i>No-Action – 15 years of shipping</i> SNL/NM to NNSS	NNSS ^c	LLW/MLLW (480)	675	5.7	3.4×10^{-3}	2.2	1.3×10^{-3}	5.4×10^{-7}	6.9×10^{-4}
<i>No-Action – 15 years of shipping</i> SNL/NM to WIPP	WIPP	TRU (15)	300	0.30	1.8×10^{-4}	0.096	5.8×10^{-5}	2.9×10^{-11}	1.3×10^{-5}
TOTAL	--	--	--	6.18	3.7×10^{-3}	2.50	1.5×10^{-3}	5.4×10^{-7}	7.5×10^{-4}
<i>Modernized Operations – 15 years of shipping</i> SNL/NM to/from LANL	LANL	SNM (128)	100	0.039	2.3×10^{-5}	0.044	2.6×10^{-5}	2.7×10^{-10}	$1.1 \times 10^{-5}{}^b$
<i>Modernized Operations – 15 years of shipping</i> SNL/NM to/from LLNL	LLNL	SNM (45)	1,050	0.14	8.4×10^{-5}	0.16	9.5×10^{-5}	9.6×10^{-10}	$3.9 \times 10^{-5}{}^b$
<i>Modernized Operations – 15 years of shipping</i> SNL/NM to INL and/or WIPP	INL/WIPP	SNM (120)	565 (avg)	0.20	1.2×10^{-4}	0.23	1.4×10^{-4}	1.4×10^{-9}	$5.6 \times 10^{-5}{}^b$

Alternative/ Transport Segments	Offsite Destination or Origination	Radiological Material (estimated peak number of shipments)	Segment Distance	Incident-Free ^a Crew Total Dose (person-rem)	Incident-Free ^a Crew Total Risk (LCFs)	Incident-Free ^a Population Total Dose (person-rem)	Incident-Free ^a Population Total Risk (LCFs)	Accident ^a Annualized Radiological Risk (LCFs/yr)	Accident ^a Non-Radiological Risk (# of traffic-accident fatalities/yr)
Modernized Operations – 15 years of shipping SNL/NM to “other” 6 candidate NNSA/DOE/Private locations	Various	SNM or other Nuclear Material (6)	1,370 (avg)	0.024	1.5×10^{-5}	0.028	1.7×10^{-5}	1.7×10^{-10}	$6.8 \times 10^{-6}{}^b$
Modernized Operations – 15 years of shipping SNL/NM to/from INL and/or PNNL	INL/PNNL	SNM (irradiated fuel) (80)	1,035 (avg)	7.5	4.5×10^{-3}	13.4	8.0×10^{-3}	2.8×10^{-9}	$2.8 \times 10^{-4}{}^b$
Modernized Operations – 15 years of shipping SNL/NM to NNSS	NNSS ^c	LLW/MLL (480)	675	5.7	3.4×10^{-3}	2.2	1.3×10^{-3}	5.4×10^{-7}	6.9×10^{-4}
Modernized Operations – 15 years of shipping SNL/NM to WIPP	WIPP	TRU (20)	300	0.40	2.4×10^{-4}	0.13	7.7×10^{-5}	3.9×10^{-11}	1.7×10^{-5}
TOTAL^d	--	--	--	14.0	8.4×10^{-3}	16.2	9.7×10^{-3}	5.54×10^{-7}	1.1×10^{-3}
Expanded Operations – 15 years of shipping SNL/NM to/from LANL	LANL	SNM (128)	100	0.039	2.3×10^{-5}	0.044	2.6×10^{-5}	2.7×10^{-10}	$1.1 \times 10^{-5}{}^b$
Expanded Operations – 15 years of shipping SNL/NM to/from LLNL	LLNL	SNM (45)	1,050	0.14	8.4×10^{-5}	0.16	9.5×10^{-5}	9.6×10^{-10}	$3.9 \times 10^{-5}{}^b$
Expanded Operations – 15 years of shipping SNL/NM to INL and/or WIPP	INL/WIPP	SNM (120)	565 (avg)	0.20	1.2×10^{-4}	0.23	1.4×10^{-4}	1.4×10^{-9}	$5.6 \times 10^{-5}{}^b$

Alternative/ Transport Segments	Offsite Destination or Origination	Radiological Material (estimated peak number of shipments)	Segment Distance	Incident-Free ^a Crew Total Dose (person-rem)	Incident-Free ^a Crew Total Risk (LCFs)	Incident-Free ^a Population Total Dose (person-rem)	Incident-Free ^a Population Total Risk (LCFs)	Accident ^a Annualized Radiological Risk (LCFs/yr)	Accident ^a Non-Radiological Risk (# of traffic-accident fatalities/yr)
<i>Expanded Operations – 15 years of shipping</i> SNL/NM to “other” 6 candidate NNSA/DOE/Private locations	Various	SNM or other Nuclear Material (6)	1,370 (avg)	0.024	1.5×10^{-5}	0.028	1.7×10^{-5}	1.7×10^{-10}	6.8×10^{-6} ^b
<i>Expanded Operations – 15 years of shipping</i> SNL/NM to/from INL and/or PNNL	INL/PNNL	SNM (irradiated fuel) (80)	1,035 (avg)	7.5	4.5×10^{-3}	13.4	8.0×10^{-3}	2.8×10^{-9}	2.8×10^{-4} ^b
<i>Expanded Operations – 15 years of shipping</i> SNL/NM to NNS	NNSS ^c	LLW/MLL (720)	675	8.6	5.2×10^{-3e}	3.3	2.0×10^{-3}	8.1×10^{-7}	1.0×10^{-3}
<i>Expanded Operations – 15 years of shipping</i> SNL/NM to WIPP	WIPP	TRU (80)	300	1.6	9.6×10^{-4}	0.51	3.0×10^{-4}	1.6×10^{-10}	6.7×10^{-5}
TOTAL^d	--	--	--	18.1	0.011	17.7	0.011	8.2×10^{-7}	1.5×10^{-3}

a. Cumulative risks from shipments over the entire action period (15 years for all alternatives) are shown for incident-free transportation; annualized risks over the action periods are presented for accidents.

b. Includes additional traffic-accident risks associated with two potential escort vehicles accompanying each shipment of SNM.

c. All LLW/MLLW shipment impacts are conservatively and consistently evaluated by assuming such materials are exclusively transported to NNS, although LLW/MLLW can be transported to a DOE/CAP-accredited commercial facility.

d. Collective totals under the Modernized and Expanded Operations Alternative conservatively acknowledge the possibility that some legacy nuclear material (including Pu-ICE as well as other potential SNM) ultimately destined for disposal as TRU waste at the WIPP may initially be transported to INL or WIPP for research/testing, characterization, waste reduction, and/or recycling, prior to being sent to the WIPP for final disposition. Moreover, the totals also conservatively acknowledge (and subsume) the possibility that ACRR-related SNM (irradiated fuel) may be transported to/from INL and/or PNNL for potential reconditioning activities as opposed to being strictly performed onsite at SNL/NM.

NOTES: Scientific notation is used to simplify the presentation; as a clarifying example, 6.2×10^{-3} is the same as 0.0062, or one chance of an LCF in 161 years. Presented impact values throughout the table may be subject to slight deviations from calculated values due to rounding.

A.5.11 Infrastructure

This section is reserved.

A.5.12 Materials Management and Waste Management

This section is reserved.

A.5.13 Human Health and Safety

This section is reserved.

A.5.14 Accident Analysis & Intentional Destructive Acts

This section is reserved.

A.5.15 Socioeconomics

This section is reserved.

**A.6 REASONABLY FORESEEABLE EFFECTS OF PROPOSED ACTIONS –
SUPPLEMENTAL INFORMATION**

This section provides information that supplements and supports the material presented in Chapter 6 of the main document.

A.6.1 Introduction

The following analyses combine the effects from proposed actions at SNL/NM in Chapter 5 with the reasonably foreseeable effects from proposed actions by other entities in Chapter 6. These analyses were used to support the impacts provided in Table 6-3.

“Reasonably foreseeable” means sufficiently likely to occur such that a person of ordinary prudence would take it into account in reaching a decision. The reasonably foreseeable effects can be viewed as the impacts on the environment that result from incremental impacts of NNSA’s Proposed Action when added to the impacts of other reasonably foreseeable proposed actions.

A.6.2 Land Use and Airspace

Key metrics in the analysis of land use include (1) the footprint of new facilities and infrastructure, (2) the amount of land disturbance, and (3) a qualitative analysis of consistency with current land use plans, classifications, and policies. For airspace, a qualitative analysis of consistency and compatibility with airspace use is the key metric.

Other Actions on KAFB. The land uses associated with the continued operations and new projects proposed at KAFB have been evaluated specifically in the existing NEPA documents

(DAF 2023a; DAF 2023b; and DAF 2023c). Although DAF plans to construct new facilities on previously disturbed land to the extent possible, some previously undisturbed land will likely be required. In addition to the SNL/NM-proposed expanded energy projects (i.e., up to 1,200-acre utility-scale PV + CSP project that would be sited on KAFB property and the 210-acre solar array that would be sited at NSTTF), and the KAFB proposed 500-acre solar array, approximately 10–20 acres of new land disturbance is likely annually on KAFB (300 acres total over the 15-year period of analysis). In total, about 2,210 acres of land could be disturbed. Because of the relatively large size of KAFB (51,588 acres), the reasonably foreseeable land disturbance from the SWEIS alternatives (342.1 acres) and the other actions on KAFB (2,210 acres) would affect about 4.9 percent of the currently undisturbed land within KAFB (i.e., 2,552.1/51,888).

Aircraft operations at KAFB, including relocating the Special Operations Command AC-130J Ghost Rider Formal Training Unit to KAFB, would add to airspace operations in and around SNL/NM. Although the AC-130J squadron would increase overall flight activities by about 3.5 percent on KAFB, additional airspace impacts would not likely be noticeable in the overall context of aircraft operations in the area (DAF 2023b). The changes in activities on the KCNSC would not change or noticeably expand land use within KAFB.

Other Actions off KAFB. In May 2024, the City of Albuquerque and Bernalillo County updated the Albuquerque/Bernalillo County Comprehensive Plan (hereafter, “the 2024 Comprehensive Plan”) (CABQ 2024), which serves as a framework for development in the Albuquerque area while also preserving history and traditions and respecting the environment. The 2024 Comprehensive Plan has major significance for how land could be developed/impacted, and it also serves as a primary tool for land use decision-making. Developable land in Bernalillo County and the City of Albuquerque is constrained by private ownership; adjacent tribal lands; and topographic features, including the Rio Grande Valley, the mountain ranges to the east, the volcanic escarpment to the west, and the steeply sloping Rio Puerco Valley further west.

The 2024 Comprehensive Plan estimates that through 2040, the population in Bernalillo County will grow at an average annual rate of about 2 percent, with corresponding growth in residential and commercial building permits.²⁹ These activities would continue to result in land disturbances as the population and economic activity increase. Future development would be consistent with the 2024 Comprehensive Plan. The 2024 Comprehensive Plan acknowledges city or county zoning and permitting requirements, and it protects parks, recreation, and the regional open space network. This will “conserve natural and cultural resources and environmental features, to create a sense of place and unique character, and to provide educational and low-impact recreational

²⁹ Although the 2024 Comprehensive Plan estimates that the population in Bernalillo County will grow at an average annual rate of approximately 2 percent, the New Mexico Legislative Finance Committee estimates that population projections between 2021 and 2040 show a gradual increase in population, with an average annual rate of approximately 0.2 percent, which is higher than the projected state-wide growth rate of 0.1 percent (NMLEGIS 2021). Because the socioeconomic ROI for this SWEIS is larger than Bernalillo County, the 0.2 percent average annual growth rate is used in this SWEIS.

opportunities. Preserving acequias, agricultural land, and unique natural features as Open Space will protect the natural resources and ecological functions of the land as well as the cultural aspects of the landscape and land uses” (CABQ 2024).

The airport master plan predicts minimal land use impacts when viewed against the existing airport land use. Projects expected include relocating the Runway 8 landing threshold 600 feet west, relocating the Runway 12 threshold 600 feet southeast, taxiway improvements, and minor terminal projects (e.g., Concourse B is planned to be extended to the east for two additional aircraft gates; the west terminal taxi lane will be moved further west, requiring removal of the belly freight building; a new airline services building is planned for the west support area, along with an office building). With regard to impacts on airspace, the airport master plan predicts that annual operations at the Sunport will grow from a low of 125,000 to 156,000, and based aircraft will grow from 165 in 2014 to 220, over the next 20 years (ABQ 2020).

The Mesa del Sol development is expected to occur over a 40-year span and would develop about 9,000 acres of the 12,900-acre site. This development would add to land disturbances as the population and economic activity increase.

In 2022, the Forest Service issued its ROD for the CNF Land Management Plan (CNF ROD) (87 FR 42438 and USFS 2022). The CNF ROD provides for new management areas that include a focused restoration management area (318,148 acres); backcountry recreation conservation management area (36,547 acres); and 14,900 acres designated as additional wilderness areas. These new management areas would continue to preserve natural features and protect undeveloped lands.

A.6.3 Visual Resources

The key metric in the analysis of reasonably foreseeable effects to visual resources is compatibility with the existing viewshed.

Other Actions on KAFB. Continued operations on KAFB will include construction projects, demolition activities, and infrastructure improvements over the next 15 years, but changes to the industrialized landscape at KAFB are not expected. Although the AC-130J squadron would increase flight operations by about 3.5 percent, no change in visual impacts is expected when balanced against other aircraft operations in the area. Construction and road improvements in the region would cause temporary visual impacts from construction equipment and additional traffic. Long-term visual impacts after construction are similar to current view. The current management of CNF would continue to preserve and protect the forest’s viewshed and landscape.

A.6.4 Geology and Soils

Key metrics in this analysis are (1) amount of soil disturbance and (2) potential for causing erosion or soil loss.

Other Actions on KAFB. Continued operations on KAFB will include a variety of construction projects, demolition activities, and infrastructure improvements over the next 15 years that would

disturb soils. As discussed in Section A.6.2, the combined land disturbance from the SWEIS alternatives (342.1 acres) and the other actions on KAFB (2,210 acres) would affect about 4.9 percent of the currently undisturbed soils within KAFB (i.e., 2,552.1/51,588).

Other Actions off KAFB. Soils in undeveloped locations off KAFB could be disturbed by development activities (particularly for residential, office, and industrial uses) as the population increases. The Mesa del Sol development is expected to disturb soils on about 9,000 acres of the 12,900-acre site. Any such development would comply with the established city or county general plans and zoning requirements. The new management areas in the CNF (i.e., a focused restoration management area [318,148 acres], backcountry recreation conservation management area [36,547 acres], and 14,900 acres designated as additional wilderness areas) would continue to preserve natural features and protect undeveloped lands.

A.6.5 Water Resources and Hydrology

Key metrics in assessing the reasonably foreseeable effects on water resource include (1) increases in impervious areas and stormwater effects, (2) analysis of effluents and the potential for surface/groundwater contamination, and (3) potential floodplain impacts. Section A.6.11 addresses consumption (water use) and the availability of water as part of the infrastructure analysis.

Other Actions on KAFB. In total, about 394.8 acres of impervious surface could be added as a result of NNSA and DAF actions on KAFB over the 15-year planning period. As a result, an additional 0.76 percent (i.e., 394.8/51,588) of KAFB lands would become impervious surfaces, which would not be expected to significantly impact stormwater management or effects. Continued operations on KAFB would comply with wastewater discharge permit limits and requirements to minimize potential impacts to surface water and groundwater quality and provide assurance that operations are protective of water resources.

Other Actions off KAFB. In the CNF ROD, the Forest Service concluded that “implementing the land management plan is expected to maintain and improve water quality and satisfy all state water quality requirements.”

Economic growth and development in the City of Albuquerque and Bernalillo County would increase impervious surfaces and could impact stormwater management. Although the amount of impervious surfaces created cannot be quantified, two goals of the 2024 Comprehensive Plan are to (1) match stormwater treatment techniques and practices to the density/intensity of land use and (2) develop requirements and technical standards that enhance the ability of street trees and vegetation to contribute to groundwater recharge, stormwater runoff retention, and erosion control. These actions could decrease adverse impacts from city growth.

A.6.6 Air Quality

Key metrics presented in the air quality analysis for air emissions include quantities of projected air emissions and comparisons to air quality standards and de minimis thresholds. Section 5.13 presents potential human health impacts from radiological emissions.

Other Actions on KAFB. DAF assessed the potential impacts on air quality for the actions described in Chapter 6, Table 6-1, and concluded that those proposed actions would not be expected to result in a significant impact on air quality (DAF 2023a; DAF 2023b; DAF 2023c; and DAF 2024). The air emissions associated with operations at the Conventional High Explosive SimulaTed Nuclear Test (CHESTNUT) Site and Joint Use Area on KAFB result in plumes of PM about 20, 50, and 80 feet into the air, and the quantity of materials³⁰ released during tests are comparable to the quantity of materials released by common fireworks. The total amount of material released over 1 year of explosives testing at the CHESTNUT Site and Joint Use Area on KAFB would be roughly equivalent to five or six firework shells from a typical Fourth of July fireworks show (DAF 2024).

DAF is actively pursuing the development of additional energy sources (solar and geothermal) to supply the everyday energy needs of KAFB. Candidate sites at KAFB for a solar array would be up to 500 acres in size and would allow for a generating capacity of 10 to 20 MW. The use of solar and geothermal energy to supply the everyday energy needs of KAFB, discussed in Section A.6.2, could have a long-term beneficial impact on regional air quality by reducing the amount of GHG emissions from KAFB. No changes to the KAFB air emission inventory would likely occur from the expanded energy projects (KAFB 2018).

Other Actions off KAFB. As discussed in Section 4.6.1, the Albuquerque-Bernalillo County area is in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. One of the goals of the 2024 Comprehensive Plan is to “maintain good air quality that complies with federal standards to safeguard public health and enhance quality of life for all residents” and to “protect residents... through the permitting process and enforcement” (CABQ 2024). Development activities such as the Mesa del Sol would be required to comply with all applicable permitting requirements.

The airport master plan commits to the betterment of regional air quality by supporting efforts to reduce emissions from Sunport users and enacting policies to reduce emissions from Aviation Department-controlled sources. Specific initiatives include:

- Prepare annual emissions reports;
- Transition to all-electric ground support equipment by 2025; and
- Transition to 100 percent alternative fuel/low-emission fleet vehicles by 2035 (ABQ 2020).

³⁰ Materials to be used include alkali metals (lithium, sodium, potassium, rubidium, and cesium), alkali earth metals (magnesium, calcium, strontium, and barium), transition metals (scandium, titanium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, and zinc), and lanthanide metals (lanthanum, cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, holmium, erbium, thulium, ytterbium, and lutetium). Heat reaction sources to be used would include titanium, boron, cesium nitrate, potassium nitrate, sodium nitrate, and tungsten (VI) oxide (DAF 2024).

Highway improvements by NMDOT in Bernalillo County and the City of Albuquerque would cause temporary, localized emissions of criteria pollutants. Similar to actions proposed on KAFB and SNL/NM, these highway improvement projects would be subject to local air permitting requirements for dust control and would be unlikely to exceed *de minimis* standards.

Air quality in the CNF is within regulatory levels for NAAQS, and the trend based on projected emission inventories appears to be stable or is improving for most pollutants. For the CNF, the Forest Plan aims to strike a balance between reducing the risk of uncharacteristic catastrophic wildfire and maintaining historical levels of carbon stocks (USFS 2021 and 87 FR 42438). There are no other identified actions to assess in the context of reasonably foreseeable impacts when assessing Forest Service activities in conjunction with NNSA SWEIS proposed alternatives.

With regard to GHG emissions, Albuquerque has “pledged” to seek to halve carbon emissions by 2030 (CABQ 2021). The Albuquerque area generates about 6 million metric tons of carbon dioxide equivalent (MMT CO₂e) annually (CABQ 2020). Under any of the SWEIS alternatives, GHG emissions from SNL/NM activities would account for a maximum of 2.3 percent of annual GHG emissions in the Albuquerque area.

A.6.7 Noise

Key metrics presented in the noise analysis include (1) identification of construction and operational noise sources and (2) a qualitative analysis of potential noise levels offsite.

Other Actions on KAFB. The ambient noise environment at KAFB is affected mainly by DAF and civilian aircraft operations, automotive vehicles, and live-fire weapons on testing and training ranges. In the developed northwestern portion of the installation, the commercial and military aircraft operations at the Sunport are the primary source of noise. Civilian and military aircraft at the adjacent KAFB/Sunport significantly impact the ambient noise around SNL/NM, as aircraft arrivals and departures pass directly over SNL/NM properties. The noise generated by aircraft is between 65–75 dBA and extends into the TA-IV section of SNL/NM and the City of Albuquerque (MRCOG 2013). Aircraft operations at Sunport and KAFB, including expansion of civilian flight traffic and relocation of the Special Operations Command AC-130J Ghost Rider Formal Training Unit to KAFB, would continue to add to ambient noise levels in the area (DAF 2023b).

DAF estimated that explosives testing within the CHESTNUT and Joint Use Area ranges would generate less than 65 dBA at nearby sensitive receptors, including inhabited areas of the Pueblo of Isleta more than 6 miles to the southwest (DAF 2024). In most cases, explosive events heard outside of the KAFB boundary resemble a dull thud or a short burst (less than 3 seconds). To minimize these noise impacts, test events are coordinated with KAFB to ensure that tests are conducted when atmospheric conditions would minimize sound propagation (SNL 2021a).

Other Actions off KAFB. The majority of the actions identified in Chapter 6, Table 6-2, would include intermittent and temporary construction activities unlikely to incrementally increase impacts to the noise levels in the ROI. Consequently, no additional impacts beyond those considered in Chapter 5 are expected.

A.6.8 Biological Resources

Key metrics presented in this analysis include (1) disturbances to land/vegetation, (2) impacts on habitats wildlife and Special Status Species, and (3) wetland impacts.

Other Actions on KAFB. Construction activities on KAFB would result in adverse impacts on wildlife species from the loss or disturbance of habitat. Impacts on wildlife species would be reduced where possible by locating new facilities with existing development. Unavoidable new development outside of existing developed areas would be sited close to developed areas and/or areas no longer serving as effective wildlife habitat. Proper site selection would minimize impacts on biological resources by avoiding sensitive or important biological areas, such as suitable habitat for threatened or endangered species, floodplains, and wetlands, and would be done in accordance with the KAFB INRMP. BMPs would be implemented to minimize impacts (KAFB 2018). Although there is no evidence of western burrowing owls (a federal species of concern) on the CHESTNUT Site and Joint Use Area, ground-disturbing activities could indirectly impact the owls and their habitats (DAF 2024). The AC-130J squadron would increase flight operations by about 3.5 percent, which could increase the potential for bird strikes in the area (DAF 2023b).

The KAFB Wildland Fire Management Plan (KAFB 2022) establishes goals and objectives to manage wildland fuels to reduce the risk of wildfire within the unimproved and semi-improved lands of KAFB. The KAFB Wildland Fire Management Plan also supports the restoration of habitat to historical norms to improve the suitability of habitat for all natural resources located on KAFB. As noted in that plan, DAF intends to “develop and then implement a robust collaborative fuels management program that reduces the overall fire risk for the installation and surrounding communities, improves and restores natural habitat, and removes invasive species from the landscape” (KAFB 2022). Together, the wildland fire risk reduction treatments on SNL/NM-managed lands and KAFB would have a long-term benefit to species by reducing deaths and protecting habitat from devastating fire impacts.

Other Actions off KAFB. One of the goals of the 2024 Comprehensive Plan is to “protect crucial habitat...by limiting the density and intensity of adjoining development, encouraging wildlife corridors and buffers, and mitigating the impacts of development” (CABQ 2024). Although development activities such as Mesa del Sol would occur and would have adverse impacts on wildlife habitats, goals such as this would decrease impacts and help to preserve and maintain healthy habitats for wildlife in the city and county. Construction activities associated with NMDOT projects and regional development could continue to impact wildlife species from the loss or disturbance of habitat.

The current and proposed actions at CNF would continue to preserve and protect ecological resources on those lands. The implementation of the CNF ROD will minimize risks to ecological integrity by supporting the resiliency of forested ecosystems toward reference conditions and restoring historic fire regimes.

A.6.9 Cultural and Paleontological Resources

The key metric for this resource is a qualitative analysis of the potential to impact cultural and paleontological resources. As identified in Section 5.9, the potential direct and indirect impacts analyzed for cultural resources include physical destruction or damage from ground disturbance, erosion, or changes to historic buildings or structures. Other impact analyses for cultural resources include changes to historic settings such as the cultural landscape and historic properties and districts.

Other Actions on KAFB. As described in a 2023 KAFB ICRMP (KAFB 2023), KAFB has conducted an installation-wide survey of archaeological and cultural resources, including on KAFB-permitted lands, but their survey did not include NNSA-owned lands or DOE withdrawn lands. KAFB has significant historic and prehistoric resources from most of the cultural periods recognized in central New Mexico, dating from the Paleoindian through the recent historic periods. Both archaeological sites and historic structures have been evaluated for eligibility for inclusion in the NRHP. Military-related buildings and structures include 271 eligible for the NRHP. A total of 741 archaeological sites were recorded within the KAFB boundary, and 251 have been determined to be eligible for the NRHP (KAFB 2023).

As a federal installation, KAFB performs cultural resources research, consultation, oral history interviews, sample field investigations, and field surveys to identify historic properties and minimize cultural resources impacts. The KAFB ICRMP identifies the process to determine whether any cultural resources will be affected by the undertaking on KAFB lands. For example, proposed projects on KAFB land will be evaluated via cultural resource geospatial reference and a determination made of whether a potential adverse effect is happening with cultural resources and of the appropriate action that is needed, such as an NHPA Section 106 consultation. The potential for an area to contain cultural resources is largely site specific; consequently, without site-specific project information, no specific quantitative assessment can be performed relative to reasonably foreseeable effects. In addition, because KAFB has limited public access (i.e., gates and fences), cultural resources are generally better protected than in offsite areas. Compliance with applicable laws and regulations pertaining to cultural resources would be expected to reduce impacts resulting from actions.

Other Actions off KAFB. Chapter 11 of the 2024 Comprehensive Plan is devoted to heritage conservation and identifies goals and policies for enhancing and preserving the unique cultural and historic resources in the region. Although it is beyond the scope of this SWEIS to specifically discuss all of those goals and policies, NNSA incorporates them by reference and acknowledges that they could guide non-federal decisions to enhance and preserve the unique cultural and historic resources in the region. Any future development would comply with city or county general plans and zoning requirements, which would be expected to protect parks, recreation, and the regional open space network to “conserve natural and cultural resources and environmental features, to create a sense of place and unique character, and to provide educational and low-impact recreational opportunities. Preserving acequias, agricultural land, and unique natural features as Open Space will protect the natural resources and ecological functions of the land as well as the cultural aspects of the landscape and land uses” (CABQ

2024). The Mesa del Sol development could impact cultural resources but would be minimized by compliance with the NHPA.

The current and proposed actions at the CNF would continue to preserve and protect cultural resources on those lands. The CNF ROD addresses the management of historic and contemporary cultural uses by tribes and traditional communities.

A.6.10 Traffic and Transportation

Reasonably foreseeable traffic effects were determined by comparing current traffic levels with projected traffic increases associated with the alternatives and general area-wide regional growth. Key metrics presented in this analysis include (1) traffic changes on area roads and (2) potential impacts to the public and transport crews from shipments of radiological and hazardous materials.

A.6.10.1 Local Transportation

Other Action on KAFB. The total workforce population for both KAFB and SNL/NM (about 23,000 workers) accounted for about 14 percent of the approximately 163,000 vehicles using public roadways around SNL/NM and KAFB during 2022 (DAF 2023a). Based on the analysis in Section 5.10.3, the SNL/NM workforce could increase by about 4,872 workers under the Expanded Operations Alternative once steady-state operations are reached. This could add about 9,700 daily vehicle-counts to local roadways.

In addition, expansion of operations at KAFB (as a result of the United States Space Force Shock Thermodynamics Applied Research Facility (STARCOM) Delta 11 and 12 Beddown and AC-130 Formal Training Unit Relocation) could add about 500 additional workers to KAFB and about 1,000 additional daily vehicle-counts to local roadways, assuming round trips (DAF 2023a and DAF 2023b). The mixed-use development along Gibson Avenue could also increase local traffic. In addition, population growth in the ROI is expected to increase by about 0.2 percent annually (refer to Section 4.10), which would increase local daily vehicle counts by an additional 3 percent over 15 years. In total, traffic increases would change the LOS on area roads, especially Eubank Boulevard. Flexibilities in start times, duty hours, and telework would help to alleviate peak traffic volume.

Other Actions off KAFB. Economic growth in the Albuquerque metropolitan area is expected to continue over the next 15 years, which could further increase the population and development in the region and contribute to increased local traffic. NMDOT projects would be expected to improve transportation and reduce road congestion. The Mesa del Sol master plan includes two new interchanges providing access to I-25 that would be financed as part of the development.

A.6.10.2 Radiological Transportation

As discussed in Section 5.10, all alternatives would involve offsite and onsite shipment of radiological materials and wastes during operations.

Table A-47 presents the reasonably foreseeable radiological impacts on transport workers and the general population from past, present, and reasonably foreseeable future proposed actions (the table includes both DOE and non-DOE actions). In addition, the table shows the potential impacts from future transportation activities associated with the SNL/NM SWEIS alternatives. As shown in Table A-47, as a result of past and future radiological transportation (1953–2073), approximately 256–258 latent cancer fatalities (LCFs) to crews, and 263–264 LCFs to the population along transportation routes, would be expected to occur. These are statistical estimates based on conservative assumptions and analyses, and they assume that 1 LCF occurs for every 1,666 person-rem of exposure (refer to Section 5.13). Of these impacts, SNL/NM radiological transportation impacts from any of the SWEIS alternatives would account for much less than 0.01 percent of the reasonably foreseeable transportation impacts to crews or the population through 2073.

Table A-47. Reasonably Foreseeable Radiological Transportation Effects

Action	Crew Dose (person-rem)	LCFs	Population Dose (person-rem)	LCFs
<i>Past, Present, and Reasonably Foreseeable Future DOE Actions as Identified in the Surplus Plutonium Disposition [SPD] Supplemental Environmental Impact Statement (SEIS) (NNSA 2015)</i>				
Historical (spent nuclear fuel to Savannah River Site) – (1953–1993)	49	0.03	25	0.02
Past, present, and reasonably foreseeable DOE actions ^a	30,900	18.5	36,700	22.5
<i>Additional Reasonably Foreseeable Future DOE Actions since Publication of the SPD SEIS</i>				
Permanent disposal or interim storage of spent nuclear fuel ^b	5,600–5,900	3.4–3.5	1,100–1,200	0.66–0.72
Greater-than-Class-C waste EIS ^c	180	0.1	68	0.04
WIPP Supplement Analysis ^d	492	0.3	383	0.23
Production of tritium in a commercial light-water reactor ^e	25–60	0.02–0.04	2.7–12	0.0–0.01
SPD SEIS Proposed Action ^f	230–650	0.4	150–580	0.3
Savannah River Site Pit Production EIS ^g	580.5–901	0.4–0.48	334–455	0.17–0.23
Versatile Test Reactor EIS preferred alternative ^h	1,878	1.13	1,764	1.06
Total DOE Actions	38,680–41,052	23–24.6	39,500–41,200	24–25
<i>Past, Present, and Reasonably Foreseeable Future Non-DOE Actions</i>				
Enrichment facility in Lea County ⁱ	1,500	0.90	450	0.27
Eagle Rock enrichment facility ^j	3,350	2.01	60,000	36
GE Global laser enrichment ^k	242	0.15	419	0.25
American Centrifuge plant ^l	285	0.17	390	0.23
General radioactive material transport (1943–2073) ^a	384,000	230	338,000	203
Total Non-DOE Actions	389,000	233	399,000	239

Action		Crew Dose (person-rem)	LCFs	Population Dose (person-rem)	LCFs
SUBTOTALS		427,680–430,052	256–258	438,500–440,200	263–264
SNL/NM SWEIS	No-Action Alternative ^m (over 15 years)	6.09	0.0037	2.4	0.0014
	Modernized Operations Alternative ^m (over 15 years)	6.09	0.0038	2.4	0.0015
	Expanded Operations Alternative ^m (over 15 years)	9.8	0.0068	3.8	0.0081
TOTAL IMPACTS (up to 2073)		427,686–430,062	256–258	438,502–440,204	263–264

- a. Does not include the doses from shipping greater-than-Class-C waste.
- b. DOE 2008c, Table 8-14; assumed the Yucca Mountain, Nevada, surrogate for repository or interim storage.
- c. DOE 2016b, Table 4.3.9-1, pp. 4-68 and 4-69.
- d. DOE 2009, Table 2.
- e. DOE 2016c, Table F-12; calculated from LCFs.
- f. NNSA 2015.
- g. NNSA 2020, Table 5-7.
- h. DOE 2022a; DOE 2022b (preferred alternative).
- i. NRC 2005; values presented are for 30 years of operation.
- j. NRC 2011, Table 4-12.
- k. NRC 2012, Table 4-14.
- l. NRC 2006.
- m. Impact indicators are from Section 5.10 of this SWEIS.

A.6.11 Infrastructure

This section discusses the reasonably foreseeable effects on utilities and energy supplies from the SWEIS alternatives in conjunction with proposed action by other entities. Consistent with the information in Section 5.11 for the continued operation of SNL/NM, key metrics presented in this infrastructure analysis are (1) consumed quantities of water, sanitary wastewater, electricity, and fuel (petroleum and natural gas); and (2) discussion of the current infrastructure systems to meet demands (i.e., existing capacity).

Other Actions on KAFB. By 2040, the combined SNL/NM and KAFB electricity usage is estimated to increase to about 600,000 MWh. Site capacity is expected to increase as new “site-generated” and substation project(s) are brought online. However, capacity may become a limiting factor in the future. SNL/NM is currently conducting a site-wide electrical infrastructure study to identify system limitations and recommend the necessary upgrades to support future growth and ensure reliable power delivery. Proposals at both SNL/NM and KAFB to increase solar power production would be expected to add more than 200 MW of capacity, which would reduce reliance on offsite energy supply. Offsite energy is secured by WAPA on SNL/NM and KAFB’s behalf through power purchase agreements.

Consumption of jet fuel would increase because of 3.5 percent flight operations of the AC-130J, but it would not contribute to reasonably foreseeable effects because no jet fuels are used at SNL/NM for similar flight operations.

Water is supplied to KAFB by six groundwater wells and two distribution systems that have a collective water-pumping maximum capacity of about 2.9 billion gallons per year. In 2017 (the most recent date for which this information was available), KAFB pumped a total of 744 million gallons of water from these wells. KAFB can also purchase water from ABCWUA to meet demand during peak periods; however, the amount of water purchased from the city has been negligible since 1998 (DAF 2023b). Regarding the new actions at KAFB identified in Chapter 6, Table 6-1, DAF concluded that current water supply would be able to support the additional personnel who would be stationed at KAFB as part of those proposed actions (DAF 2023a; DAF 2023b; and DAF 2023c).

Other Actions off KAFB. The current and proposed actions at the CNF would not substantially change any current utility or energy usage within CNF management.

Based on economic growth in the ROI, it is reasonable to assume that development activities would result in increased utility demands as the population and economic activity increase. By 2040, the ROI population is expected to increase by about 3 percent over the current baseline (refer to Section 4.15). Consequently, it is reasonable to assume that utility demands in the ROI would increase by about 3 percent by 2040.

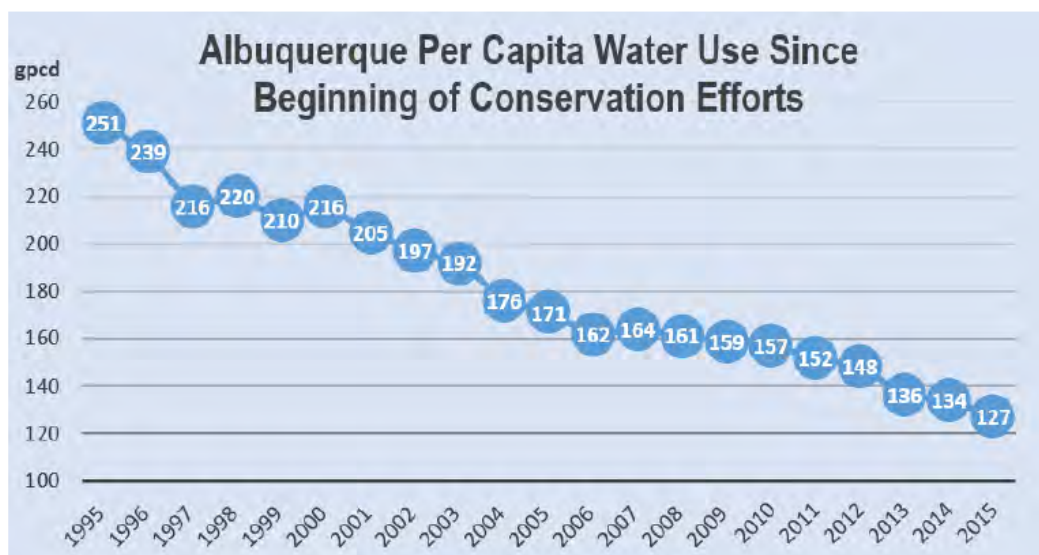
On a state-wide level, New Mexico's electricity supply portfolio includes coal (35.5 percent of supply), wind (30.2 percent), and natural gas (28.4 percent). In March 2019, Governor Michelle Lujan Grisham signed Senate Bill 489, the Energy Transition Act, which sets a resource standard for the state and increases the state's renewable portfolio standard to at least 80 percent by 2050. According to the latest Energy Information Agency data available, net generation from wind in New Mexico was expected to increase from 6.5 percent in 2015 to 30.2 percent in 2021 (CNEE 2022).

New Mexico has substantial wind, solar, hydroelectric, biomass, and geothermal energy potential and is expanding its renewable energy supply. In the future, all of New Mexico's planned electricity-generating capacity additions are expected to come from renewables or natural gas (CSIS 2018). Due to continuous technological improvements and declining costs, renewables in New Mexico are expected to exceed traditional energy sources and are positioned to meet future energy demands across the state (CSIS 2018).

In July 2024, NNSA formed a partnership with Los Alamos County to provide DOE's two national laboratories in New Mexico (LANL and SNL/NM) with electricity produced from Los Alamos County's new Foxtail Flats solar and energy storage project, which is proposed to be operational by March 1, 2026. When fully operational in 2026, the Los Alamos County Foxtail Flats Solar and Storage Project is expected to provide 170 MW of solar energy and 320 MWh of battery storage to LANL and SNL/NM (NNSA 2024). The SNL/NM share of the energy produced by Foxtail Flats amounts to about 15 percent of the combined energy requirement.

With regard to water supply, regionally, ABCWUA works to provide reliable, high-quality, affordable, and sustainable water supply, wastewater collection treatment, and reuse systems to support a healthy, environmentally sustainable, and economically viable community. As Figure A-55 shows, as a result of conservation efforts, regional water use per capita decreased by

about 50 percent over the period 1995–2015 (ABCWUA 2016). *Water 2120: Securing Our Water Future* (ABCWUA 2016) outlines a plan to ensure continued success over the next century. As part of that plan, ABCWUA is preparing for a range of possible water supply and demand scenarios. The utility has concluded that Albuquerque has sufficient supplies in its current portfolio of groundwater and surface water to serve a growing community, even in a drier future, through at least the 2060s under the worst-case scenario and well into the 2080s under other scenarios (ABCWUA 2016).



Source: ABCWUA 2016.

gpcd: gallons per capita daily

Figure A-55. Albuquerque Per Capita Water Use, 1995–2015

The airport master plan commits to expanding energy efficiency measures and expanded energy opportunities. Specific initiatives include:

- Incorporate all recommended energy efficiency measures by 2025;
- Retrofit rental car PV system by 2025;
- Construct credit card parking lot PV system by 2030; and
- Expand PV capacity to achieve onsite energy goals for all Aviation Department facilities by 2035 (ABQ 2020).

A.6.12 Materials Management and Waste Management

While no wastes are disposed of at SNL/NM itself, wastes are generated at the site and transported offsite for disposal.

Other Actions on KAFB. KAFB is a large-quantity generator of hazardous waste (USEPA ID #NM9570024423). The installation’s hazardous waste management plan provides guidance for waste identification, storage, transportation, and disposal and establishes the procedures to

comply with applicable federal, state, and local standards for solid waste and hazardous waste management (DAF 2023b). KAFB does not generate radioactive waste. Solid waste generated at KAFB is collected by a contractor and disposed of at the City of Albuquerque's Cerro Colorado Landfill. The Cerro Colorado Landfill receives about 6,574 cubic yards per year from KAFB (DAF 2023a). The KAFB C&D landfill accepts only C&D waste from permitted contractors working on the installation and has a net waste capacity of 7.2 million cubic yards. As of December 31, 2020, the remaining capacity of this landfill was 2.11 million cubic yards. In 2019 and 2020, an average of 134,000 cubic yards of C&D waste per year was deposited in this landfill (DAF 2023a).

Other Actions off KAFB. LANL generates radiological waste, LLW, and MLLW that may be sent to the same offsite facilities as that from SNL/NM. Currently, LANL LLW/MLLW accounts for about 16 percent of the LLW/MLLW disposed of at NNSA annually. In the future, LANL's LLW/MLLW is anticipated to increase and could account for 25 percent or more of the LLW/MLLW disposed of at NNSA annually (NNSA 2025).

The maximum amount of TRU waste estimated to be generated by LANL over approximately the next 15 years would be 8,580–8,850 m³. This volume of TRU waste would represent about 5 percent of the LWA TRU waste disposal volume capacity of 175,564 m³. Based on the 2023 ATWIR, it would also represent 8.6 percent of the available WIPP capacity (NNSA 2025). Compliance with the WIPP LWA disposal capacity limit is determined by proven and audited procedures and processes implemented for the WIPP facility by the Carlsbad Field Office. The Carlsbad Field Office monitors and tracks the actual defense-related TRU waste volume emplaced at the WIPP facility to ensure compliance with the WIPP LWA and acts in a timely and appropriate manner to ensure that the needs of the DOE complex are met.

LANL also generates hazardous waste that is sent to a variety of offsite commercial TSDFs. In the LANL Draft SWEIS, NNSA has concluded that the forecast amounts of hazardous waste generated at LANL could increase from 27 to 40 percent over the next 15 years and that hazardous waste treatment at permitted commercial facilities should be able to easily accommodate that increase (NNSA 2025).

With regard to solid waste, as of September 2022, there are 27 permitted landfills within New Mexico that have adequate capacity to handle any reasonably foreseeable solid wastes generated by SNL/NM, LANL, and other actions addressed in this analysis of reasonably foreseeable effects (NNSA 2025).

A.6.13 Human Health and Safety

Occupational injuries and deaths associated with other reasonably foreseeable proposed actions would be independent of the activities and impacts at SNL/NM and would not provide meaningful information regarding reasonably foreseeable effects. Consequently, the key metrics presented in this analysis are (1) the radiological doses and the potential LCF risk to the public and (2) impacts associated with non-radiological effluents.

Other Actions on KAFB. None of the other actions on KAFB result in radiological emissions that could cause reasonably foreseeable effects to the public. With regard to non-radiological emissions, compliance with permit requirements provides assurance that operations would be protective of human health and the environment.

Other Actions off KAFB. Because of the distance between LANL and SNL/NM, individual operations of the two national laboratories are unlikely to have reasonably foreseeable effects to human health. This conclusion is supported by the following: (1) the annual collective dose to a population within 50 miles in every direction from SNL/NM is estimated to be a maximum of 0.05 person-rem for the Expanded Operations Alternative, (2) the estimated annual collective dose from LANL operations to a population within 50 miles in every direction from LANL is estimated to be a maximum of 6.73 person-rem (NNSA 2025), (3) potential radiological doses to individuals decrease rapidly as a function of distance from the source, and (4) the majority of individuals who would receive doses from both national laboratories would be the subset of the collective populations that reside north of SNL/NM and south of LANL (e.g., between Santa Fe and Albuquerque). Nonetheless, for completeness, this section estimates the potential human health impacts to the public from radiological air emissions at both SNL/NM and LANL. Even under the extremely conservative assumption that the entire 50-mile population around SNL/NM (1,075,207 persons) also received the full annual collective dose from LANL operations, the population dose would be 6.78 person-rem per year.³¹ An annual dose of 6.78 person-rem would result in an LCF risk of 0.004 (statistically, this means that 1 LCF could be expected every 250 years). Therefore, no reasonably foreseeable health impacts would be expected.

A.6.14 Accidents and Intentional Destructive Acts

Key metrics for the accident and intentional destructive acts analysis include potential impacts to workers and the offsite public from an accident that could involve multiple facilities.

Actions on and off KAFB. As discussed in Section 5.14, this SWEIS evaluates the potential accident consequences of a seismic event that could occur in the region and provides an assessment of the estimated consequence of this natural phenomena hazard for each facility with radiological materials, which would be the highest consequence event. Based on the seismic event analyzed, the total accident risk to the offsite population as a result of multiple radiological facilities being involved in a design-basis seismic event (with accompanying fire) would be about 0.0001 additional LCFs per year.

With regard to chemical accidents, although the MESA Complex has the largest inventory of hazardous chemicals at SNL/NM, as discussed in Section 5.14.2.2, no scenarios were identified that have the potential for significant offsite (public) consequences. As acknowledged in Appendix D, Section D.3.6, there would be a potential for localized impacts to workers;

³¹ To put this population dose into perspective, if each of the 1,075,207 persons within 50 miles of SNL/NM were to receive a chest x-ray, the population dose would be about 10,752 person-rem.

however, the implementation of passive engineering controls would minimize the potential for offsite consequences.

As reported in Appendix D, Section D.4.3, of this SWEIS, substantive details of intentional destructive acts scenarios and security countermeasures are not released to the public because disclosure of this information could be exploited. Depending on the nature of an intentionally destructive act, impacts may be similar to those described in bounding accident impact analyses prepared for this SWEIS.

KAFB operations do not have the potential for radiological accidents (DAF 2023a; DAF 2023b; and DAF 2023c). Additionally, none of the KAFB NEPA documents identified in Chapter 6, Table 6-1 and Table 6-2, reported any potential accidents involving hazardous materials. Accidents and intentional destructive acts from actions on and off KAFB have the potential to cause impacts that would be independent of SNL/NM activities.

A.6.15 Socioeconomics

Key metrics presented in the socioeconomics analysis are (1) employment and population changes, (2) changes in economic activity (e.g., earnings/monetary value added), (3) impacts to housing and community services, and (4) disproportionate and adverse impacts to human health or populations. A disproportionate and adverse impact refers to an impact or risk of an impact on the natural or physical environment in an at-risk population in the socioeconomic ROI that appreciably exceeds the environmental impact on the general population of New Mexico.

Other Actions on KAFB. During FY 2020, the workforce at KAFB was more than 23,000 individuals, including more than 3,500 active-duty military personnel (DAF 2023a), the personnel at SNL/NM, and other non-military staff. Direct payroll expenditures from the installation totaled \$2.26 billion for FY 2020. When non-payroll expenditures associated with KAFB and local job creation value are included, the total economic impact exceeded \$7.4 billion, with local economic impact representing about \$4.6 billion of that total (DAF 2023a). The KAFB planned actions identified in Chapter 6, Table 6-1, would add to, but not notably change, the overall positive impacts from already occurring KAFB activities.

Potential disproportionate and adverse environmental and human health effects on at-risk populations associated with KAFB's continued operations and proposed new projects have been evaluated specifically in existing NEPA documents (DAF 2023a; DAF 2023b; and DAF 2023c). DAF plans to construct new facilities on KAFB, including a Satellite Communications Ground Terminal facility, and to repurpose the Zia Park area. These actions would have no disproportionate and adverse impact on at-risk populations (DAF 2023a and DAF 2023c). Aircraft operations at KAFB, including relocating the Special Operations Command AC-130J Ghost Rider Formal Training Unit to KAFB, would add to airspace operations in and around SNL/NM (DAF 2023b). While the short-term noise and traffic impacts on at-risk populations would be considered disproportionate, the impacts would not be significant (DAF 2023b). Current and proposed actions at KAFB are not expected to have any disproportionate and adverse human health or environmental effects on at-risk populations; therefore, under all

alternatives, SNL/NM activities are not expected to substantially contribute to reasonably foreseeable effects (DAF 2023a; DAF 2023b; DAF 2023c; and DAF 2024).

Other Actions off KAFB. Economic growth in the Albuquerque metropolitan area is expected to continue over the next 15 years. Economic growth generally causes population levels and development in the ROI to increase. The total labor force in the ROI is expected to increase from 336,801 workers in 2022 (BLS 2023) to 366,936 workers in 2040, an 8.1 percent increase (refer to Appendix C, Section C.14.2, for methodology). The Mid-Region Council of Governments, in its modeling efforts for the *Futures 2040 Metropolitan Transportation Plan*, forecast the addition of 130,000 jobs between 2015–2040 in Albuquerque and Bernalillo County (CABQ 2024). Despite limited growth in some industries, the council forecast that overall job numbers in Bernalillo County will grow by 39 percent between 2012–2040. All sectors will see job growth, but the distribution of jobs will continue to advance most prominently in the services sector, with a predicted 49 percent job growth in 2040 (CABQ 2024).

Because the national laboratories at LANL and SNL/NM are within 60 miles of each other, they can both draw from the same pool of potential employees and both contribute to the socioeconomic conditions of the surrounding area. The SNL/NM ROI is Bernalillo county. According to LANL, there were 15,326 employees at LANL in 2022. By approximately 2038, there could be about 18,551 employees at LANL. Currently, most LANL employees reside in Santa Fe and Sandoval counties, while only about 6 percent of the LANL workforce resides in Bernalillo County, where SNL/NM is located (NNSA 2025). Impacts to employment and economic activity include direct, indirect, and induced economic impacts that could potentially result from project activities. Overall, both national laboratories have been located in their respective communities for over 70 years, provide generally positive socioeconomic benefits to the surrounding area, and do not have projected changes that would significantly stress housing or public services in the ROI.

Implementation of the CNF ROD will contribute to social and economic sustainability by providing benefits to at-risk populations, improving the quality of life, and offering opportunities for income and jobs. The CNF would continue to provide for traditional, cultural, and spiritual values of particular interest to tribes/pueblos. Due to Forest Service management actions, no populations in the CNF land management area would experience disproportionate adverse human health impacts or environmental effects (87 FR 42438).

The 2024 Comprehensive Plan acknowledges the historic patterns of disinvestment and environmental impacts to at-risk populations. The plan describes a need to develop and implement strategies to address the environmental health hazards that may affect at-risk populations more severely in some areas of the community.

A.7 REFERENCES FOR APPENDIX A

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APPENDIX B
SCOPING FOR THE SNL/NM SWEIS

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Appendix B – Scoping for the SNL/NM SWEIS

B.1 BACKGROUND

The U.S. Department of Energy (DOE) National Nuclear Security Administration (NNSA) Sandia Field Office (SFO) is preparing a new site-wide environmental impact statement (SWEIS) for continuing operations at Sandia National Laboratories/New Mexico (SNL/NM). The new SWEIS will replace the 1999 SNL/NM SWEIS, DOE/EIS-0281 (DOE 1999). As part of this effort, SFO conducted a public scoping process and requested comments to help define the environmental issues and the range of reasonable alternatives to be analyzed in this new SWEIS.

B.2 SCOPING PROCESS

Scoping is part of the overall process for involving the public in the preparation of an environmental impact statement (EIS).

The objectives of the scoping process are to:

- notify interested persons, agencies, and other groups about the Proposed Action and the alternatives being considered;
- solicit comments about environmental issues, alternatives for the Proposed Action, and other items of interest; and
- consider those comments in the preparation of the EIS.

The scoping period began on April 21, 2023, with the publication of the Notice of Intent (NOI) in the *Federal Register* (FR) (88 FR 24607) and ended on June 5, 2023. The NOI notified the public that NNSA intended to prepare a SWEIS on continuing SNL/NM operations and to invite other federal agencies, Native American tribes, state and local governments, and the general public to participate in the scoping process. The NOI presented background information on SNL/NM and the SWEIS preliminary alternatives and solicited comments on the proposed scope of the SWEIS. SFO collected scoping comments in writing from those responding to the NOI and those who presented comments at the public scoping meetings. Written comments outside of the scoping meetings were accepted if submitted via the U.S. Postal Service (USPS) or email.

In addition to these public scoping activities, consistent with Section 106 of the National Historic Preservation Act (Title 54 of the *United States Code* [U.S.C.] § 300101et seq.) and Executive Order (EO) 13175, in March 2023, NNSA sent written requests to initiate government-to-government consultation with 27 tribal nations. These solicitations offered an opportunity to provide comments, concerns, and suggestions for the scope of this SNL/NM SWEIS, including the identification of any properties of religious and cultural significance that may be affected at SNL/NM.

NNSA subsequently reached out to three tribes that expressed further interest, and conducted follow-up meetings with two of these three tribes. The third tribe did not agree to a follow-up

meeting. SFO continues to reach out to interested tribes, and it continues to schedule information meetings with interested tribal nation representatives to provide further information about the SWEIS, understand issues or concerns, and identify any properties of religious and cultural significance that may be affected at SNL/NM.

NNSA also continues to consult with the Pueblo of Isleta, which is participating as a collaborating entity in the preparation of this SWEIS.

B.3 PUBLICITY

To inform the public about the scoping meetings, a postcard, Figure B-1, was designed and sent via the USPS on April 21, 2023, to those with physical mailing addresses (about 260 individuals) in the project mailing list database, which was compiled by SFO.

Figure B-1. SNL/NM SWEIS Scoping Meeting Postcard

The National Nuclear Security Administration, a semi-autonomous agency within the U.S. Department of Energy, is holding two public scoping meetings to invite public input on the scope and alternatives to consider in the Sandia National Laboratories/New Mexico Draft Site-Wide Environmental Impact Statement (SWEIS). The SWEIS will analyze the potential environmental impacts of the reasonable alternatives for continuing Sandia New Mexico operations for approximately the next 15 years. The public comment period began with publication of the Notice of Intent in the <i>Federal Register</i> and runs until June 1, 2023.		   Sandia National Laboratories												
There are multiple ways to provide comments on the proposed scope and content of the SEIS.	You can provide written comments: <table border="0"> <tr> <td>by email to:</td> <td>or by U.S. mail:</td> </tr> <tr> <td>SNL-SWEIS@nnsa.doe.gov</td> <td>SNL/NM SWEIS Comments</td> </tr> <tr> <td></td> <td>National Nuclear Security Administration</td> </tr> <tr> <td></td> <td>Sandia Field Office</td> </tr> <tr> <td></td> <td>PO Box 5400</td> </tr> <tr> <td></td> <td>Albuquerque, New Mexico 87185</td> </tr> </table>		by email to:	or by U.S. mail:	SNL-SWEIS@nnsa.doe.gov	SNL/NM SWEIS Comments		National Nuclear Security Administration		Sandia Field Office		PO Box 5400		Albuquerque, New Mexico 87185
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	PO Box 5400													
	Albuquerque, New Mexico 87185													
In-Person Public Scoping Meeting Tuesday, May 9, from 6:30 to 8:50 p.m. MDT New Mexico Veterans Memorial, Museum, and Conference Center 1100 Louisiana Blvd SE Albuquerque, New Mexico 87108 Preceded by a poster session beginning at 5:30 p.m. Listen-in only: www.zoomgov.com/j/1618755753, toll free 833-568-8864, Meeting ID: 161 875 5753	Virtual Public Scoping Meeting Thursday, May 11, from 6:30 to 8:50 p.m. MDT Access by Internet: https://www.zoomgov.com/j/1608652437 Access by Telephone: 833-568-8864 (toll free) Meeting ID: 160 865 2437 Virtual platform opens at 6:15 pm													
Each meeting will open with a presentation at 6:30 p.m., followed by the collection of verbal public comments on the scope of the SWEIS beginning at about 7:10 p.m. The in-person meeting will also be available virtually for listening only. Each speaker will have 3 minutes for their comments, or more depending on the number of commenters. Please send requests for special accommodations to SNL-SWEIS@nnsa.doe.gov at least 2 weeks before the meeting. Additional details, including further instructions on accessing the Zoom link, are available at https://www.sandia.gov/about/environment.														

An email announcement, including the information contained in Figure B-1, was also sent to those on the SFO mailing list with email addresses (about 450 individuals).

In addition, digital advertisements were run in the online version of the *Albuquerque Journal* from April 24, 2023, to May 11, 2023. These advertisements were served up 168,000 times in

various formats and clicked on 313 times to link to the project website at <https://www.sandia.gov/about/environment/sweis/>.

A print advertisement, shown in Figure B-2, was designed to provide details on the meetings and the ways to comment. It ran in the *Santa Fe New Mexican* newspaper and the *Albuquerque Journal* on Monday, April 24, 2023, and Saturday, May 6, 2023.

	National Nuclear Security Administration Sandia National Laboratories/New Mexico Site-Wide Environmental Impact Statement	
Public Scoping Meetings		
The U.S. Department of Energy's National Nuclear Security Administration (NNSA) is holding two public scoping meetings to invite public input on the scope and alternatives to consider in the Sandia National Laboratories/ New Mexico Draft Site-Wide Environmental Impact Statement (SWEIS). The SWEIS will analyze the potential environmental impacts of the reasonable alternatives for continuing Sandia New Mexico operations for approximately the next 15 years.		
Tuesday, May 9, 2023 In-Person Public Meeting: 6:30 p.m. – 8:50 p.m. MDT (preceded by a poster session starting at 5:30 p.m.)		
Location: New Mexico Veterans Memorial, Museum, and Conference Center 1100 Louisiana Blvd SE, Albuquerque, New Mexico 87108 The in-person meeting will also be available virtually for listening only at https://www.zoomgov.com/j/1618755753, toll free 833-568-8864, Meeting ID: 161 875 5753		
Thursday, May 11, 2023 Virtual Public Meeting: 6:30 p.m. – 8:50 p.m. MDT		
Access by Internet: https://www.zoomgov.com/j/1608652437 Access by Telephone: 833-568-8864 toll free Meeting ID: 160 865 2437		
Each speaker will have 3 minutes for their comments, or more depending on the number of commenters. Please send requests for special accommodations to SNL-SWEIS@nnsa.doe.gov at least 2 weeks before the meeting. Additional details and meeting materials, including further instructions on accessing the Zoom link, are available at https://www.sandia.gov/about/environment. Submit written comments on the scope of the SWEIS by email to: SNL-SWEIS@nnsa.doe.gov Or by U.S. mail to: Attn: SNL/NM SWEIS Comment National Nuclear Security Administration, Sandia Field Office PO Box 5400 Albuquerque, New Mexico 87185 Please mark envelopes and emails as: SNL-SWEIS Comments Comments must be received/postmarked by June 5, 2023		

Figure B-2. SNL/NM SWEIS Scoping Meeting Print Advertisement

B.4 SCOPING MEETINGS

The NOI, along with the publicity campaign described in Section B.3, also gave information on the dates, times, and venues for the two public scoping meetings. One live (in-person) meeting was held in Albuquerque, New Mexico, on May 9, 2023, and one virtual (online) meeting was held on May 11, 2023. At each of these meetings, NNSA presented background information about SNL/NM, information on its proposal to prepare this SWEIS, and the alternatives that are to be analyzed in the SWEIS. The public was invited to present verbal or written comments at the scoping meetings.

Table B-1 provides the total number of attendees, speakers, and comments from each public scoping meeting, including government and contractor staff. The number of attendees at the in-person meeting is based on those who chose to sign in; not all attendees may have signed in as requested. The number of virtual attendees may include duplicates as participants may have disconnected and reconnected in different ways (e.g., via Zoom first and later by phone).

Table B-1. Scoping Meeting Number of Attendees and Commenters

Meeting Location	Number of Attendees	Number of Verbal Commenters	Number of Written Commenters
Live (In-Person)	18 ^a	0	0
Virtual (Online)	49 ^b	2	2 ^c
TOTAL	67	2	2

- Includes a media person and five SNL/NM staff members who signed in. An additional 21 participants listened in remotely, including 9 SFO, National Technology & Engineering Solutions of Sandia, LLC (NTESS), and SC&A staff associated with the project.
- Includes 21 SFO, NTESS, and SC&A staff associated with the project.
- These were comments submitted through the Zoom chat box and read into the official record by the meeting moderator.

In addition to the comments received during the virtual scoping meeting, 18 individuals or organizations submitted written comments via the USPS and email.

B.5 SUMMARY OF SCOPING COMMENTS AND RESPONSES

During the public scoping process, including the scoping meetings, a total of 22 individuals and organizations made verbal or written comments. These comments, summarized in Table B-2, are organized based on the relevant SWEIS sections and the comment topics. All of these comments have been reviewed and considered at various stages during the preparation of this SWEIS. Many are explicitly addressed in the pertinent sections of the first seven chapters of this SWEIS, as noted in the Summary Response column of Table B-2.

Table B-2. Summary of Scoping Comments and Responses

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
The SWEIS must clearly discuss the reasons why any alternatives were not evaluated in detail. The environmental impacts of each alternative should be clarified, quantified, and presented in comparative form.	Proposed Action and SWEIS Alternatives	4	As described in Chapters 1 and 3, this SNL/NM SWEIS analyzes the range of reasonable alternatives in accordance with National Environmental Policy Act (NEPA) requirements. Section 3.6 explains why other alternatives were considered but not analyzed in detail. A summary comparison of alternatives and potential environmental impacts is presented in Chapter 3 and the SWEIS summary.
There are comments about the accuracy of the data presented in the 1999 SNL/NM SWEIS, what changes will be made to update and improve that data, and how to best present it in a flowing narrative that is more understandable to technical experts and analysts, as well as the general public.	Proposed Action and SWEIS Alternatives	2	To ensure accuracy, this SNL/NM SWEIS uses the best reasonably available information. To make the information more understandable to the general public, this SWEIS uses plain language. To improve readability, technical information and other project details have been placed in appendices.
The alternatives analyzed in the SWEIS should include the Annular Core Research Reactor (ACRR); plans for other nuclear reactors or fuels for those reactors; all construction activities; storing all waste onsite, including the quantities of waste to be managed onsite; and reduced operations based on the new budget bill that requires cuts in discretionary spending.	Proposed Action and SWEIS Alternatives	6	The analyzed alternatives in this SNL/NM SWEIS include consideration of the ACRR and other proposed reactor facilities. Construction activities and waste management are analyzed. As explained in the NOI, a reduced operations alternative is not a reasonable alternative because it would not meet the purpose and need, and therefore it is not analyzed in detail. NNSA requested comments on this approach in the NOI.
There are comments about this SWEIS covering 15 years of operations, and that more frequent public reviews (every 10 years) are necessary. Given the number of changes that have occurred at SNL, it is irresponsible for SNL to wait over 25 years to provide the public with a SWEIS process.	NEPA Process	11	As part of the implementation of this SWEIS, NNSA and SNL will review individual proposed actions to verify they fall within the scope of this SWEIS, and potential environmental impacts are addressed based on the current understanding and requirements. NNSA will also reevaluate the analysis in this SWEIS in accordance with the requirements of NEPA, as amended and the DOE NEPA Implementing Procedures.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
NEPA requires consideration of reasonable alternatives to preferred federal proposals. The process must be unprejudiced by the fact that hundreds of millions of dollars are spent on nuclear weapons research and production at SNL.	NEPA Process	2	This SNL/SWEIS has been prepared in accordance with all applicable NEPA procedures, which require objective analysis of all reasonable alternatives.
Request that SNL/NM place all reference documents on the DOE website or include links to the reference documents in the Draft SWEIS when it is published.	NEPA Process	2	NNSA has made key reference documents publicly available online at https://www.sandia.gov/about/environment/sweis/ . Links to many documents are also provided on the website.
The Pueblo of Isleta requests government-to-government consultation with DOE and requests cooperating agency status on the SNL/NM SWEIS. DOE and NNSA must also consider historical and ongoing impacts of past weapons testing activities and work directly with the Pueblo of Isleta to obtain information relating to the unexploded ordnance (UXO) sites identified by the Pueblo, the exact acreage swept and cleared thus far, and ongoing mitigation needs.	NEPA Process	5	Consistent with Section 106 of the National Historic Preservation Act and Executive Order 13175, NNSA has initiated government-to-government consultation with the Pueblo of Isleta, and the Pueblo of Isleta has agreed to participate as a collaborating entity in the preparation of this SNL/NM SWEIS. NNSA continues to work with the Pueblo of Isleta to address issues regarding UXO.
Regarding the Modernized Operations Alternative, objection to the unsafe nuclear operations at SNL and opposition to the construction of a Next Generation Pulsed Power Facility for testing nuclear weapons – an activity that has been prohibited by the Nuclear Test Ban Treaty.	General Support or Opposition	6	Comment noted. NNSA will consider the risks from existing and proposed new nuclear and other facilities that are analyzed in this SNL/NM SWEIS in its decision-making process. SNL/NM uses modeling and simulation to assert the safety, security, and reliability of the stockpile without explosive nuclear testing.
Opposition to initiatives related to and/or expenditures for more nuclear weapons, nuclear power, pit production, depleted uranium munitions, armed drones, or generation of more nuclear waste.	General Support or Opposition	2	Comments noted. The description of the purpose and need for agency action in this SNL/NM SWEIS (Section 1.3) explains NNSA mission requirements.
Propose that the money being used for any weapons research be diverted to civil infrastructure, health, education, broadband, etc.	General Support or Opposition	5	The comment is outside the scope of analysis.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
Support for a comprehensive SWEIS for the safe operation of SNL and the protection of the public and the environment.	General Support or Opposition	4	This SNL/NM SWEIS addresses risks of operations to workers, the public, and the environment.
Opposition to the operation of the ACRR (or the Transient Reactor Test Facility) over air quality and structural integrity.	General Support or Opposition	4	Comments noted.
Comments over continuing to spend taxpayer dollars on nuclear weapons production and suggestions that these funds could be better used elsewhere, such as for cleanup, nonproliferation, and renewable energy. Support for the ratification of nuclear treaties and meeting international law requirements.	Out-of-Scope Comments	3	Comments noted. These issues are outside the scope of analysis.
SNL/NM must continue to perform the 5-year study of the Mixed Waste Landfill called for in the 2005 and 2016 New Mexico Environmental Department (NMED) Final Orders.	Out-of-Scope Comments	1	Comment noted. NNSA complies with all applicable NMED requirements.
Comments about a comprehensive Resource Conservation and Recovery Act (RCRA) permit at SNL/NM; issues with operating under a dated, incomplete permit; and not complying with current RCRA permit requirements.	Out-of-Scope Comments	3	RCRA and other waste management permitting is discussed in Sections 4.12 and 5.12.
Comments about the proposed Chemical Metallurgical Research Replacement and Plutonium Pit Production at Los Alamos National Laboratory (LANL). Describe the relation/role of SNL/NM facilities that will support research, development, or other operations related to certifying new plutonium pits and tritium production.	Out-of-Scope Comments	3	While these LANL facilities and tritium production operations are outside the scope of this SNL/NM SWEIS, the proposed role of SNL/NM facilities is discussed in detail, including in the statement of the purpose and need (refer to Section 1.3) and facility descriptions throughout the document.
Comments that this SNL/NM SWEIS will be a repeat of the 2011 SWEIS that was never issued.	Out-of-Scope Comments	1	NNSA has addressed this by issuing this SNL/NM SWEIS.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
Kirtland Air Force Base (KAFB) and other federal operations and cleanup actions within the scope of the SNL/NM SWEIS analysis must be considered.	Out-of-Scope Comments	3	KAFB operations and cleanup are not within the scope of direct environmental impact analysis in this SNL/NM SWEIS. The potential for indirect or reasonably foreseeable effects of KAFB operations is analyzed in Chapter 6.
SNL must consider (and include as an unclassified summary in the SWEIS) the potential impacts from all possible accident scenarios or acts of terrorism, including chemical or radiological releases from seismic events, equipment malfunctions, transportation, liquid natural gas inventories, and the Steam Plant.	Accident Analysis	7	This SNL/NM SWEIS considers the potential impacts of the range of reasonably foreseeable accident scenarios as required by DOE NEPA regulations and guidance (refer to Section 5.14). Per DOE policy, this document also considers potential impacts from intentional destructive acts, as described in Section 5.14.6 and Section D.4.3. Note that SNL/NM no longer has a Steam Plant; it was demolished in 2010.
SNL must describe the continued transport and management of special nuclear material, including the potential for human exposure, environmental accidents, and the potential impacts from terrorist activities.	Accident Analysis	5	These topics are discussed in Sections 5.10 and 5.14.
There needs to be a full accident analysis (that describes levels of protection and includes environmental and public health/environmental justice issues) of the existing ACRR that has no primary or secondary containment. The new planned reactor must have complete containment.	Accident Analysis	3	These issues are discussed in Section 5.14.
All Defense Nuclear Facilities Safety Board (DNFSB) recommendations, along with Nuclear Watch New Mexico accident scenarios to address concerns expressed by the DNFSB, should be incorporated into the SWEIS.	Accident Analysis	2	Although the discussion of specific DNFSB recommendations is out of scope, relevant nuclear safety issues and risks are analyzed in Section 5.14.
Evaluate, for all SNL site activities, existing conditions; quantify air emissions; specify the emission sources; and prepare a construction emissions mitigation plan.	Air Quality	2	Existing conditions regarding air emissions are discussed in Section 4.6. If NNSA determines mitigation beyond standard construction best management practices is warranted, NNSA will prepare a plan to address mitigation commitments in the Record of Decision for this SNL/NM SWEIS, as appropriate.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
The SWEIS should include a comprehensive monitoring system that meets state and federal requirements to accurately measure radionuclide and hazardous waste concentrations.	Air Quality	11	NNSA complies with all applicable requirements regarding monitoring. Results are reported in Annual Site Environmental Reports and summarized in this SNL/NM SWEIS.
Provide information on material inventories, consumption, air emissions and process requirements for HERMES III, Radiographic Integrated Test Stand (RITS), Gamma Irradiation Facility, Explosives Applications Laboratory, and the Laurence Canyon Burn Site (from JP-8 jet fuel and other contaminants).	Air Quality	6	Relevant information is provided in facility descriptions (Appendix A, Section A.2) and analyses (Chapter 5) throughout the document. Information about air emissions is provided in Sections 4.6 and 5.6 and other appropriate places throughout the document. Note that RITS-6 was decommissioned in 2015, no longer operates as an accelerator, and is slated for dismantlement and removal.
SNL should perform a detailed investigation into the design of site monitoring systems and upgrade all systems to demonstrate compliance with regulatory standards, to be better prepared for the releases of radioactive materials in case of accidents or disasters, and to establish a level of information/data and assurance at SNL that is equivalent to that at other DOE facilities. This should include a specific isotope analysis for strontium-90, americium-241, and plutonium-239/240. NMED monitoring programs should also be expanded to provide an independent verification of all SNL monitoring data.	Air Quality	15	NNSA complies with all applicable requirements regarding site monitoring. Results are reported in Annual Site Environmental Reports and summarized in this SNL/NM SWEIS. Expansion of NMED monitoring programs is outside of the scope of analysis for this SNL/NM SWEIS.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
The analysis should follow the January 2023 updated CEQ guidance (88 FR 10097) on consideration of greenhouse gases (GHG) and climate change under NEPA, including consideration of the action’s resiliency/adaptation to future climate changes. Quantify emissions for criteria pollutants, hazardous air pollutants, and GHG. The emissions analysis should account for construction/demolition equipment, trucks, personnel commuting vehicles, building utilities and fuel combustion, evaporative emissions, and other emission sources as applicable. The air quality and GHG analyses should consider measures to reduce emissions, such as use of best management practices, alternative-fuel or electric vehicles and equipment, and renewable sources of electricity. Monetize impacts of GHG emissions using estimates of the social cost of GHG, as appropriate, to assist in analyzing and disclosing the impacts of a project’s GHG emissions. Include a section on climate change, with a discussion on how the project design has considered and adopted measures of resilience and adaptation to a changing climate. SNL/NM should consider how the project may exacerbate climate change. Include a discussion on how climate will change at the project location.	Air Quality	2	Air emissions are discussed in Sections 4.6 and 5.6 and other appropriate places throughout the document. NNSA will comply with all applicable Executive Orders, and consider best management practices as suggested by the commenter.
The SWEIS should analyze the impacts of climate change (e.g., with respect to fate and transport for buried waste) on SNL and include how SNL will mitigate potential future impacts of climate change on SNL.	Air Quality	5	Air emissions are discussed in Sections 4.6 and 5.6 and other appropriate places throughout the document. This SNL/NM SWEIS is not intended to support specific remedial action decisions for buried waste. This SWEIS uses conservative analytical parameters.
Analyze potential impacts to endangered flora and fauna. Analyze the impacts of radiation in all plant and animal species. Include practicable alternatives for any discharges of dredged or fill material, measures taken to avoid and minimize impacts to all aquatic habitats, and compensatory mitigation for all unavoidable impacts.	Biological Resources	3	Potential impacts on biological resources are described in Section 5.8. No impacts to plant or animal species from exposure to radiation would occur because potential exposures would be at extremely low levels for which it has been demonstrated that populations of plants and animals would be adequately protected.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
The Modernized Operations Alternative discussed in the NOI states that projects reducing the carbon footprint of operations and assisting in Net Zero initiatives would be included. How will concentrated solar power development impact migratory birds and bat species? What measures and methods will be used to monitor impacts to bird and bat species from the Proposed Action? Inventories for bird and bat species are recommended prior to further development. We would be interested in seeing within the SWEIS a description of methods that will be used to monitor impacts to bird and bat species from the Proposed Action, and what previous monitoring has revealed about impacts to bird and bat species, especially relative to other solar energy technologies.	Biological Resources	1	Potential impacts to biological resources, including birds and bats, are presented in Section 5.8. If NNSA decides to pursue implementation of concentrating solar power technology, such as a potential utility-scale CSP proposal in partnership with KAFB (refer to the description in Section 3.4), it will consider whether further studies and monitoring are warranted, as recommended by the commenter. NNSA would consult with resource management agencies, including the U.S. Fish and Wildlife Service, as appropriate. NNSA would also consider whether potential mitigation measures are warranted to protect bird and bat species. If NNSA determines that mitigation measures are appropriate, it would prepare and make publicly available a Mitigation Action Plan to address mitigation commitments in the Record of Decision for this SNL/NM SWEIS.
KAFB completed and signed an <i>Integrated National Resource Management Plan</i> (INRMP) in April 2023 that conserves federal and state-protected species, sensitive species, and other native wildlife and plants while implementing management actions for approximately the next 5 years. We encourage integrating the Proposed Action with the INRMP, including incorporation of best management practices, survey efforts, and design features from the INRMP.	Biological Resources	1	Information from the INRMP (SNL 2023) is discussed in Sections 4.8 and 5.8 (regarding biological resources). NNSA will consider best management practices and other environmental measures in the INRMP in its decision-making, including consideration of potential mitigation measures in this SNL/NM SWEIS. NNSA also may develop or adopt its own natural resource management plan.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
The SWEIS provides an opportunity to guide pollinator habitat management. A diversity of native, low-growing species is recommended to allow for minimal maintenance and mowing. A seed mix of plants with varying blooming phenology is recommended to provide nectar to pollinators for the full blooming season, including milkweed species to enhance monarch butterfly habitat. The monarch butterfly is a candidate species for listing in the Endangered Species Act. While a candidate species designation does not provide protections under the Endangered Species Act, federal agencies and project developers may choose to voluntarily incorporate conservation actions to conserve monarchs in order to prevent potential future changes to their projects.	Biological Resources	1	Section 5.8 discusses habitat management and conservation strategies for the Monarch Butterfly..
If prairie dogs are found to be present within the project area, management of prairie dogs at a sustainable level would be beneficial to maintaining ecosystem integrity, consistent with the best management practices listed in the INRMP. Inventory and monitoring of prairie dog colony size and density would greatly inform the analysis of the Proposed Action.	Biological Resources	1	Section 5.8 discusses habitat management and conservation strategies for prairie dogs.
The U.S. Fish and Wildlife Service’s publication at https://www.fws.gov/media/reducing-bird-collisions-buildings-and-building-glass-best-practices (USFWS 2021a) contains recommended practices for avoidance and mitigation of impacts to volant species, including lighting and reflective surface standards. Collisions resulting in death or injury should be monitored and reported appropriately. The Service’s publication at https://www.fws.gov/media/recommended-best-practices-communication-tower-design-siting-construction-operation (USFWS 2021b) should be utilized for any communication tower construction, maintenance, and planning. Support the incorporation of applicable sections of these documents within the SWEIS.	Biological Resources	2	Section 5.8 discusses habitat management and conservation strategies for volant species..

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
Describe all lands on KAFB/SNL that were for tribal use for cultural or religious purposes, or as resource lands for hunting and/or food gathering. Cultural and traditional site locations within the Pueblo of Isleta are maintained confidential by Isleta's traditional leadership. DOE/NNSA must engage the Pueblo of Isleta to perform a meaningful impact assessment.	Cultural and Historic Resources	2	Cultural resource issues are discussed in Sections 4.9 and 5.9. Consistent with Section 106 of the National Historic Preservation Act and EO 13175, in March 2023, NNSA sent written requests to initiate government--to--government consultation with 27 tribal nations. These solicitations offered an opportunity to provide comments, concerns, and suggestions for the scope of this SNL/NM SWEIS, including the identification of any properties of religious and cultural significance that may be affected at SNL/NM. NNSA subsequently reached out to these tribes by email, and tribal nation representatives and Tribal Historic Preservation Officers have requested further information. SFO continues to reach out to interested tribes, and it continues to schedule information meetings with interested tribal nation representatives to provide further information about this SWEIS, understand issues or concerns, and identify any properties of religious and cultural significance that may be affected at SNL/NM. NNSA also continues to consult with the Pueblo of Isleta, which is participating as a collaborating entity in the preparation of this SWEIS.
The Pueblo's Tribal Historic Preservation Officer has identified a number of significant sites on the Pueblo, including the St. Augustine Church, which was founded in 1613, that either are included in the National Register of Historic Places or are eligible for inclusion in the Register and thus for protection under the National Historic Preservation Act.	Cultural and Historic Resources	1	These topics are addressed in Sections 4.9 and 5.9.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
The Pueblo of Isleta has tribal cultural, religious, health, and safety comments about KAFB/SNL activities, including those with a potential to impact noise pollution and air quality, including military overflights; activities with a potential to impact surface water (Rio Grande) and groundwater quality; activities with a potential to impact items of cultural patrimony and traditional cultural sites; activities that impact Isleta’s wilderness areas, including increased environmental stress on Isleta’s domestic cattle herds and wildlife protected under Isleta traditional law; activities with environmental justice impacts, including the disproportionate effects the Pueblo faces as a result of historical and ongoing pollution from neighboring industrial development, as well as mechanisms to mitigate such impacts; and radiological impacts to workers, nearby residents, and the public generally.	Cultural and Historic Resources	1	NNSA continues to work with the Pueblo of Isleta to identify and address socioeconomic issues, which are discussed in Sections 4.15 and 5.15.
NEPA requires DOE to address the reasonably foreseeable effects on the 50-mile radius surrounding DOE facilities and missions. This should be expanded to include a 75- to 100-mile radius and combine the reasonably foreseeable effects of SNL, KAFB, and LANL facilities. This should also include SNL operations in Hawaii, California, and the Nevada Test Site.	Reasonably Foreseeable Effects	4	As explained in Section 4.1, the regions of influence (areas where potential impacts may occur) vary for each environmental resource. For example, for human health and safety and air quality, analysis shows that a 50-mile radius of SNL/NM is adequate to encompass all of the potential environmental impacts of site operations, including potential severe accidents. Transportation -related impacts could occur along transportation corridors outside the 50-mile radius. Reasonably foreseeable effects, including those associated with KAFB, are discussed in Chapter 6. Operations in Hawaii, California, and Nevada are outside the scope of analysis of this SNL/NM SWEIS.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
Include the environmental impacts of all existing facilities and new facilities planned for each alternative, and describe the timeframe and plans for decontamination, decommissioning, and demolition (DD&D) of any unused, closed, or planned closures of nuclear facilities at SNL, including DD&D of the Sandia Pulsed Reactor and the Steam Plant.	Facilities	9	These topics are addressed in Chapter 5. Note that SNL/NM no longer has a Steam Plant; it was demolished in 2010.
Provide a summary of activity levels for all facilities and facility groups that presents the category, description, activity type or material, units (per year) for nuclear material inventory, nuclear material consumption (including types of radionuclides), solid waste generation, low-level waste, mixed waste, hazardous waste, radioactive air emissions, transuranic waste, open burn/open detonation emissions, explosives consumption and emissions, waste water effluent, water consumption, electricity consumption, boiler energy, and facility personnel.	Facilities	1	These topics are addressed in Chapter 5.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
Request that the SWEIS analyze the environmental impacts of all work that is performed for others.	General Impacts	1	While the scope of this SWEIS focuses only on the environmental impacts of activities at SNL/NM, SNL/NM personnel also conduct a variety of activities for clients at offsite locations in the United States, including but not limited to work for other federal agencies (e.g., the U.S. Department of Defense, U.S. Department of Justice, National Aeronautics and Space Administration), state and local agencies, universities, institutions, and industrial clients. SNL/NM personnel may conduct offsite first responder training exercises and courses in support of international, homeland, and nuclear security missions. NNSA reviews all proposed activities for offsite clients (“work for others,” currently known as Strategic Partnership Projects) to ensure the activities would be conducted in a safe and environmentally sound manner, and in accordance with all applicable environmental requirements, including NEPA. These activities normally do not pose the potential for significant environmental impacts. When operating at offsite locations, the host entities remain in full operational control, with SNL/NM personnel operating as guests. Host facilities identify and help SNL/NM personnel avoid potential environmental issues, such as those concerning biological and cultural resources. Host facilities provide guidance for the protection and avoidance of migratory birds and protected species. SNL/NM personnel are responsible for following both host facility requirements and SNL corporate requirements as appropriate. SNL/NM, with oversight from NNSA, conducts NEPA reviews for all work, including offsite activities.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
All impacts on geology and soil must be analyzed. Please describe all unavoidable adverse environmental impacts. Describe any proposed mitigation. Describe all construction impacts.	Geology and Soils	1	Potential impacts on geology and soils are described in Sections 4.4 and 5.4. Potential mitigation measures and unavoidable adverse environmental impacts are discussed in Sections 5.16 and 5.17.
Describe all existing facilities, including the ACRR and the Auxiliary Hot Cell Unit, along with their ability to withstand the maximum seismic event postulated for SNL/NM, and all unavoidable adverse health (e.g., cancer risks) and environmental impacts (i.e., impacts on geology and soil). Conduct studies to determine the potential damage from these seismic events, and provide plans to mitigate the risk to residents living within a 50-mile radius of these facilities. Include any overlap with risk from substandard LANL facilities.	Geology and Soils	7	Facility accident risks, including potential impacts to offsite populations from postulated severe accidents, are analyzed in Section 5.15. No reasonably foreseeable effects related to risk overlap from potential SNL/NM facility accidents and LANL facilities would occur.
In the Draft SWEIS, SNL must present a plan to reduce the more than 120,000 pounds of hazardous waste produced annually at the Albuquerque site.	Hazardous Materials and Waste Management	7	Waste management issues are discussed in Sections 4.12 and 5.12.
The SWEIS needs to include inventories (volume and types) of all hazardous wastes currently at SNL and the additional inventories of hazardous wastes that will be produced over the future SWEIS analysis period. For these waste inventories, the SWEIS must provide a waste management plan that includes how and where the waste will be stored and/or disposed to ensure it is isolated from the environment, emergency plans to mitigate accidental releases, and the cost impacts for managing the waste.	Hazardous Materials and Waste Management	23	Waste management inventories and issues are discussed in Sections 4.12 and 5.12.
The SWEIS should include analysis of environmental impacts of wastes that are transferred to offsite private waste disposal facilities.	Hazardous Materials and Waste Management	1	Impacts from transportation of materials and wastes, including transportation of wastes to offsite facilities, are discussed in Sections 4.10 and 5.10. Impacts from the management and disposal of wastes at offsite facilities are outside the scope of analysis in this SNL/NM SWEIS.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
SNL should explain why it is exceeding prior estimates of radioactive waste at SNL/NM.	Hazardous Materials and Waste Management	1	Analyses in this SNL/NM SWEIS are based on updated estimates of wastes and materials.
Provide the inventories being maintained of explosive materials, the projected amounts, and the potential for accidents and consequences involving the explosive materials (or fires).	Hazardous Materials and Waste Management	3	The analysis of potential accidents in Section 5.14 of this SNL/NM SWEIS accounts for projected quantities of materials that could be released in an explosion or fire and pose risks to public health and safety.
Describe the history of emissions from the Hazardous Waste Management Facility; describe any emissions from beryllium and radioactive wastes from Saturn Accelerator operations in Technical Area IV, Building 981; describe the current and future projection of emissions at the Thermal Treatment Facility.	Hazardous Materials and Waste Management	3	Emissions from these and other SNL/NM facilities, and associated potential impacts on human health, are described in Section 5.13.
The SWEIS should provide the current status of the Mixed Waste Landfill and the plans for removing all waste from this landfill due to reduced concentrations of cobalt-60.	Hazardous Materials and Waste Management	3	The Mixed Waste Landfill is discussed in Section 4.12.
All analyses must address the risk to a pregnant woman farmer, her fetus, and her other children under age 18, rather than “Reference Man.”	Human Health	1	As described in Sections 4.13 and 5.13, this SNL/NM SWEIS analyzes risks to individuals and populations from exposure to hazards, such as ionizing radiation. Key metrics include estimates of latent cancer fatalities for potentially exposed individuals and populations based on appropriate radiological risk factors. Risk factors used in these estimates take account of sensitive members of populations.
The SWEIS should analyze the impacts of SNL/NM operations on worker health, public health, and the environment, including human exposures to hazardous materials. If available, please include a historical baseline of the data for comparison to existing conditions, and provide safety measures that will be implemented to ensure the protection of human health and the environment within and outside of the project area.	Human Health	8	Potential health impacts to workers and members of the public associated with exposure to hazardous materials are analyzed in Section 5.13. Existing conditions are described for the No-Action Alternative, which provides a baseline for comparison among the alternatives.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
Provide levels of gamma radiation exposures to workers and the public from HERMES III operations.	Human Health	1	Potential radiological exposures from SNL/NM facilities are analyzed in Section 5.13.
Present the death rate and sickness statistics for SNL/NM workers for SNL/NM operations. For worker safety issues, discuss which facilities have caused the contamination for workers compensated under the Energy Employees Occupational Illness Compensation Program. What are the estimated ongoing medical payments for those sick workers? What actions have been/will be taken to avoid future contamination?	Human Health	3	Worker health and safety statistics for historical and proposed SNL/NM operations, and procedures to protect workers from exposure to chemical, radiological, and other work hazards, are discussed in Sections 4.13 and 5.13. Estimates of medical payments are outside the scope of analysis.
Provide current and estimated future utilization of natural gas and electricity.	Infrastructure	2	This topic is discussed in Sections 4.11 and 5.11.
Please clearly define the project area and discuss which project components will be analyzed in the SWEIS. All current and future land use plans must be analyzed, to include policies, controls, and visual resources.	Land Use	2	The project area and proposed projects are described in Chapters 1 and 3. Land use plans are described in Sections 4.2 and 5.2, and visual resources are described in Sections 4.3 and 5.3.
The SWEIS should disclose the volume of materials, including explosives, that are proposed for open burning/open detonation (OB/OD) at SNL as well as the modeling results for the fate and transport of ash and unburned materials into the atmosphere. The SWEIS must conduct a comparable analysis of alternatives to the OB/OD of hazardous materials, including banning the practice onsite, along with a proposed timeline to implement each alternative to OB/OD.	Open Burning/Open Detonation	9	Section 3.4.3 contains a discussion of OB/OD, including alternative technologies. As explained in Section 4.6, SNL/NM conducts open burning only in accordance with permits that protect air quality. NMED has implemented an open burning permit program to manage emissions of air pollutants. The open burning permits include restrictions on the material and times that open burning can occur (20.11.21 New Mexico Administrative Code [NMAC]). SNL/NM applies for multiple open burning permits annually for treating explosives waste, detonating explosives related to research and development, disposing of explosives by burning, and igniting rocket motors.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
Use a comprehensive communication strategy, including available tools (i.e., EJ Screen, U.S. Census Bureau, area knowledge) to identify potentially impacted “at risk” populations and foster public participation by these populations, with a focus on those within a 1-mile radius of the project boundaries.	Socioeconomics	4	Socioeconomic issues are discussed in Sections 4.15 and 5.15.
DOE must address a number of questions about the local economic impact of the proposed projects, including number and duration of jobs for local residents; permanent positions that would be filled by non-local workers; annual number of construction workers needed; socioeconomic impacts to surrounding New Mexico counties, including limited housing and rising cost of living; percentage of construction costs that would stay in New Mexico; and risks of transporting materials to and from site.	Socioeconomics	1	These issues are discussed in Sections 4.15 and 5.15.
Include data that shows compliance or non-compliance with stormwater permit requirements. Include requirements of a stormwater prevention plan and a stormwater map of how the plan will be followed during construction and operations.	Water Resources	2	Stormwater and other surface water resource issues are discussed in Sections 4.5 and 5.5.
Identify and map all waterbodies from New Mexico’s Clean Water Act Section 305(b) comprehensive waterbody assessment list that are within the project scope area. Highlight which waterbodies are impaired and include information about their impairment.	Water Resources	1	Sections 4.5 and 5.5 discuss relevant surface waterbodies potentially impacted by SNL/NM operations.
Identify any potential pollutants that may be in wastewater from any operational processes and sources at SNL/NM. Describe how SNL/NM treats wastewater from current and future facilities. Include how wastewater may be reclaimed and reused if possible.	Water Resources	9	Sections 4.11 and 5.11 discuss wastewater from current and proposed future facilities.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
An estimated 25 million gallons of jet fuel has seeped into soil around KAFB, posing a potential threat to groundwater. Analyze the impacts of the leaks and what is being done to remediate the jet fuel spill. Also include additional safety measures that will be taken to avoid future fuel leaks. Include in the Draft SWEIS a description of the groundwater monitoring network, air monitoring, and contamination at the Lurance Canyon Burn Site.	Water Resources	7	Groundwater contamination issues and a discussion of the Lurance Canyon Burn Site are in Section 4.5. This SNL/NM SWEIS analyzes potential reasonably foreseeable effects from KAFB current and proposed operations; however, details about KAFB plans to remediate and prevent fuel leaks are outside the scope of analysis.
All contamination impacts on surface water and groundwater must be analyzed, including historical and future planned or unplanned releases, hazardous chemicals, or radionuclides from SNL/NM. Describe mitigation and cleanup plans. Describe construction impacts to stormwater and stormwater pollution prevention plans. Describe the economic and environmental impacts from SNL water usage and contamination of groundwater.	Water Resources	18	Surface water and groundwater contamination issues are discussed and analyzed in Sections 4.5 and 5.5.
SNL has failed to establish effective monitoring for groundwater, soil, and air as required by DOE orders, RCRA, and standard industry practice. SNL/NM should identify to the public a scheduling plan for the replacement of the many defective groundwater monitoring wells.	Water Resources	1	NNSA complies with all applicable requirements regarding monitoring in accordance with DOE orders and environmental permits. Results are reported in Annual Site Environmental Reports and summarized in this SNL/NM SWEIS.
Describe the number of gallons of groundwater that can be contaminated by the current levels of contaminants that can be attributed to SNL/NM and KAFB.	Water Resources	1	Surface water and groundwater contamination issues are discussed and analyzed in Sections 4.5 and 5.5.
Analyze the environmental impacts of drawing down the aquifers in the region, including the impacts SNL/NM and KAFB have on the local municipal water supplier.	Water Resources	9	Impacts associated with water use at SNL/NM and KAFB, including increased water demand under the Expanded Operations Alternative, are discussed in Section 5.11.
Analyze information regarding tanks in operation and leakage of prior tank operations.	Water Resources	1	Surface water and groundwater issues are discussed in Sections 4.5 and 5.5.

Summary Comment	SWEIS Section/ Comment Topic	Number of Individual Comments	Summary Response
Provide the sampling and monitoring program and results for all springs located at SNL and near SNL facilities at KAFB, including any closures of onsite water production wells at KAFB and SNL.	Water Resources	1	Surface water and groundwater issues are discussed in Sections 4.5 and 5.5.
Describe all groundwater contaminants exceeding regulatory concentrations. Provide any studies made to determine that chromium and uranium contaminants are not human-related in origin. Describe plans to remediate the groundwater contamination.	Water Resources	1	Surface water and groundwater contamination issues are discussed and analyzed in Sections 4.5 and 5.5. A detailed discussion of groundwater remediation plans is outside the scope of analysis.

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Appendix C – Methodologies Used in This SWEIS

C.1 INTRODUCTION

This *Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico* (DOE/EIS-0556) (SNL/NM SWEIS) was prepared in accordance with the U.S. Department of Energy (DOE) procedures for implementing National Environmental Policy Act of 1969 (NEPA). This appendix describes the methodologies used to assess the potential direct and indirect impacts of the reasonable alternatives for continuing SNL/NM operations for the next 15 years (2025–2040).

The level of detail in the description of each resource methodology and the corresponding analyses in the SWEIS are commensurate with the potential for impacts to the resource.

Resource methodologies are presented in the same order as the resources in Chapters 4 and 5. For each resource, the National Nuclear Security Administration (NNSA) developed key metrics to provide a comparative basis of evaluation appropriate for that resource. Appendix D presents the methodologies for addressing accidents and intentional destructive acts. The methodology for assessing reasonably foreseeable effects is presented in Chapter 6. For any new projects, a combination of design features and best management practices (BMPs) would be implemented to avoid or reduce potential environmental impacts (refer to Chapter 5, Section 5.16, of this SWEIS).

C.2 LAND USE AND AIRSPACE

C.2.1 Description of Affected Resources and Region of Influence

“Land use” is the term used to describe the designation and use of land. It represents the economic and cultural activities (e.g., agricultural, residential, commercial, industrial, recreational, conservation) that are practiced at a given place. The analysis of impacts to land use considers land use plans and policies, zoning regulations, and existing land use as appropriate for the site analyzed. This analysis identifies temporary and permanent changes of land uses associated with any of the alternatives.

The Region of Influence (ROI) for land use includes (1) Kirtland Air Force Base (KAFB), (2) SNL/NM-controlled lands and properties on and off base, and (3) abutting and nearby properties. Special consideration was given to abutting and nearby tribal lands. The land use designations of nearby locations were determined through review of land ownership maps and agency planning documents where available and land uses as observed through publicly available aerial and street imagery. The ROI includes the limits of operational/physical disturbance, as well as the construction-related impact area, which includes additional areas of temporary disturbance (e.g., laydown areas) required for construction activities.

SNL/NM’s location on KAFB and adjacent to the Albuquerque International Sunport required an analysis of how proposed land uses intersect with airspace.

C.2.2 Description of Impact Assessment

Land use changes could potentially affect previously disturbed land and undisturbed land. Key metrics in this analysis are (1) amount of land disturbance, (2) number of new facilities, and (3) a qualitative analysis of consistency with current land use plans, classifications, and policies. Activities under the No-Action Alternative and the action alternatives were reviewed to identify actions that would change or cause adverse effects to use, designation, development density, ownership, or local planning and zoning. The land use analysis also considers potential impacts resulting from the conversion of, or the incompatibility of, land use changes with special status lands, such as national parks/monuments, prime farmland, tribal lands, and other protected lands, such as federal- and state-controlled lands (e.g., public land administered by the Bureau of Land Management [BLM] or other government agency). Land use data gathered for this analysis were also used to determine impacts on the visual environment, as described in greater detail in Section C.3. With regard to airspace, the analysis focuses on any changes, disruptions, or other impacts to the current use, management, or operational procedures of existing airspace.

C.3 VISUAL RESOURCES

C.3.1 Description of Affected Resources and Region of Influence

Visual resources are natural and manmade features that give a particular landscape its character and aesthetic quality. The features that form the overall impression a viewer receives of an area include landform, vegetation, water, color, adjacent scenery, rarity, and manmade modifications. The visual ROI is the location of the facilities and actions outlined in the Proposed Action and views of the facilities and actions from both onsite and public viewpoints offsite. Special consideration is given to actions within visually sensitive locations and viewpoints from visually sensitive locations.

C.3.2 Description of Impact Assessment

The key metric in this analysis is visual compatibility (i.e., whether actions would be consistent with existing landscapes, obscure views, increase the visibility of structures or otherwise detract from the scenic perspectives of existing and planned residential developments adjacent to the sites, or cause glare). This SWEIS uses the following criteria in the visual resources analysis: scenic quality, visual sensitivity, distance, and visibility zones from key public viewpoints. The comparative analysis consists of a qualitative examination of potential changes in visual resources, scenic values (attractiveness), and modification activities that could alter the visibility of structures at each of the sites or obscure views of the surrounding landscape, and changes in land cover that could make structures more visible.

To rate the scenic quality of KAFB and surrounding areas, DOE/NNSA used BLM's Visual Resource Management (VRM) Classification System (BLM 1986). Although this classification system is designed for undeveloped and open land managed by BLM, this is one of the only systems of its kind available for the analysis of VRM and planning activities.

The VRM Classification System provides a systematic approach for evaluating the potential changes to visual resources that may result from the projects/actions and is typically used by DOE/NNSA in its NEPA evaluations. The major concepts of the BLM's VRM methodologies that this SWEIS followed are as listed:

- Establish an understanding of the existing visual character and qualities of the landscape environment of the project area.
- Determine areas from which the projects/actions would be visible.
- Estimate the visual expectations and response of the viewers to visual changes resulting from projects/actions.
- Identify the visual contrast resulting from changes to the existing landscape character.
- Assess qualities in the project area as a result of projects/actions.

C.4 GEOLOGY AND SOILS

C.4.1 Description of Affected Resources and Region of Influence

The ROI for geology and soils consists of the SNL/NM and KAFB sites and nearby offsite areas. This SWEIS presents collated and summarized information on the regional topography, structural geology, and stratigraphy. More site-specific parameters addressing soils and mineral resources are presented for a relatively smaller geographic area on SNL/NM and KAFB lands. In addition, this SWEIS evaluates the seismicity of the region surrounding the site to examine the probability of earthquakes in the area and their likely severity. This information is also used in the SWEIS evaluation of accidents from natural phenomena.

C.4.2 Description of Impact Assessment

Key metrics in this analysis include (1) the amount of soil disturbance; (2) the potential for causing erosion, soil loss, or impacts to prime farmland; and (3) analysis of whether soils and geologic features would support new facilities (e.g., potential for landslides or soil liquefaction). This SWEIS evaluates the projects/actions based on the amount of disturbance that may affect the geology and/or soils of the ROI. These impacts could include potential erosion impacts and impacts to economically viable mineral resources in the area. Impacts, if any, are evaluated and a determination made as to severity. In addition, the analysis identifies and discusses applicable seismic design input for new facilities.

C.5 WATER RESOURCES AND HYDROLOGY

C.5.1 Description of Affected Resources and Region of Influence

This section describes the methodology for analysis of water resources, including surface water, groundwater, and stormwater. Key metrics include establishing whether measures are in place to (1) control stormwater runoff and sediment transport due to construction and demolition activities, as well as for permanent increases in impervious areas, (2) promptly clean up small

environmental releases (e.g., petroleum spills, other potentially hazardous waste), and (3) confirm successful mitigation through robust monitoring programs.

Surface Water. The Affected Environment discussion in Chapter 4, Section 4.5.1, of this SWEIS includes a description of local surface water resources at KAFB, including natural drainage areas and lengths; location; and seasonal flow characteristics of floodplains, wetlands, arroyos, and watersheds extending to the Rio Grande. The ROI for surface water includes (1) onsite arroyos and the watershed downstream from SNL/NM and KAFB, which consists of Tijeras Arroyo and extends from the western KAFB boundary to the Rio Grande, (2) the Rio Grande downstream from Tijeras Arroyo, and (3) floodplains and wetlands.

Groundwater. Groundwater is described in terms of the regional groundwater system in which KAFB is located; more specifically, in terms of the local aquifers. Included in the ROI for groundwater are those water-bearing layers that could potentially be affected by SNL/NM operations. The SWEIS presents in Chapter 4, Section 4.5 the local groundwater system of alluvial and bedrock aquifers in terms of general water quality, depths from the ground surface, and rates and direction of groundwater movement. The SWEIS evaluates potential impacts to groundwater resources that could result from a potential release of contaminants during construction or during operations that could reach groundwater. The evaluation also considers whether the alternatives could affect or be affected by existing groundwater contamination and cleanup activities.

Stormwater. The impacts analysis evaluates the following: (1) possible changes in quantity or quality of stormwater runoff during construction activities and (2) the type and quantity of water needed to support construction and operations. Changes in stormwater volumes and directions have the potential to adversely impact existing discharge points or receiving waters. Spills or leaks of contaminants from heavy equipment during construction could affect stormwater runoff. The impacts analysis also evaluates the potential for projects/actions to be within the 100- or 500-year floodplains.

Key metrics presented in this analysis include (1) increases in impervious areas and stormwater effects and (2) potential floodplain impacts. Chapter 5, Section 5.8, of this SWEIS discusses potential impacts to wetlands. Section 5.12 addresses potential impacts associated with water use and wastewater.

C.6 AIR QUALITY

C.6.1 Description of Affected Resources and Region of Influence

This appendix describes the methodologies and analyses used to complete Chapter 4, Section 4.6, and Chapter 5, Section 5.6, of this SWEIS. The air quality analysis in this SWEIS includes impacts to air quality from non-radiological air emissions, greenhouse gases (GHGs), and radiological air emissions. The ROI includes SNL/NM, KAFB, and offsite areas. All analyses considered current and proposed activities over the next 15 years (2025–2040) (88 *Federal Register* [FR] 1196).

C.6.2 Description of Impact Analysis

This section describes the methods used to determine and evaluate the impacts from air emissions and GHG emissions associated with current and proposed operations. A variety of models and tools were applied to analyze non-radiological air emissions, including GHG emissions, over the 15-year period 2025–2040.

The methods used were selected based on the source emitting the air emissions, available data, and regulatory guidance.

C.6.2.1 Non-Radiological Air Emissions and Greenhouse Gas Emissions

Sources of non-radiological and GHG air emissions at SNL/NM include facility support operations, testing, and laboratory operations. Air emissions and GHG emissions are generated from the following activities:

- commuting (both contractors and staff);
- document destruction;
- electricity generation;
- explosives testing, training, and disposal;
- fire testing
- heating and cooling;
- laboratories;
- pulsed power/high voltage equipment;
- semiconductor fabrication;
- transportation of waste and other materials; and
- use of construction equipment during construction, demolition, and remediation.

The analyses in this SWEIS use a baseline of air emissions and GHG emissions from operations over the past 5 years. Under the No-Action Alternative, the analysis generally assumes that air emissions and GHG emissions will remain basically consistent with the baseline.

The facility currently develops annual reports of air emissions from boilers, generators, and chemical usage. Table C-1 presents facility-wide air emissions for the period 2018–2022. These estimates do not include air emissions from mobile sources, such as employee commuting or construction of new facilities. Lead emissions were not included, as the site does not emit lead in a reportable quantity.

Table C-1. Facility-Wide Air Emissions Averages (tons per year)

Year(s)	CO (tpy)	NO _x (tpy)	Filterable PM (tpy)	SO ₂ (tpy)	VOC (tpy)	HAP (tpy)
2022	10.64	8.02	1.67	0.09	3.28	10.68
2021	11.63	8.05	1.56	0.1	3.26	8.88
2020	11.54	9.8	1.63	0.5	3.51	8.26
2019	12.2	10.8	1.9	0.4	5.9	8.6
2018	11.7	10.2	1.8	0.4	3.7	9.9
2018–2022 (5-year average)	11.5	9.4	1.7	0.3	3.9	9.3

CO: carbon monoxide, HAP: hazardous air emissions, NO_x: oxides of nitrogen, PM: particulate matter, SO₂: sulfur dioxide, tpy: tons per year, VOC: volatile organic compound

Source: SNL 2018; SNL 2019; SNL 2020; SNL 2021; SNL 2022.

Facility-wide air emissions for the period 2018–2022 (from Chapter 4, Table 4-7) were generally consistent, from year to year, varying by less than 3 tons (about 30 percent).

The facility calculates GHG emissions in eight categories for reporting to DOE in the Sustainability Dashboard. Table C-2 presents the GHG emissions for the 6-year period 2017–2022, as reported to DOE.

Table C-2. Facility-Wide GHG Emissions (in metric tons of carbon dioxide equivalents)

Category	FY 2017 ^a	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
Facility Energy	112,728.10	130,535.90	136,755.40	140,743.10	135,808.70	125,570.20
Non-Fleet Vehicle & Equipment Fuel	369.40	548.70	1,003.10	398.10	267.30	451.50
Fleet Fuel	1,358.70	2,377.70	2,088.10	1,979.70	1,629.60	1,822.90
Fugitive Emissions	113,206.70	131,085.60	119,780.20	128,621.50	142,320.70	104,989.50
Onsite Landfills	0.00	0.00	0.00	0.00	0.00	0.00
Onsite Wastewater Treatment	0.00	0.00	0.00	0.00	0.00	0.00
Renewables	0.00	0.00	0.00	0.00	0.00	0.00
Renewable Energy Credits	-24,637.40	-32,654.20	-32,649.60	-43,951.60	-44,513.20	-66,359.30
Total (MTCO₂e)	203,025.50	231,893.70	226,977.20	227,790.80	235,513.10	166,474.80

a. GHG emissions are presented by fiscal year (FY) (October 1 through September 30).

Source: SNL 2023.

Facility-wide GHG emissions for the period 2017–2022 were generally consistent, varying by less than 69 million metric tons (MT) of carbon dioxide equivalents (CO₂e) or about 32 percent (similar to the variation in air emissions).

To quantify impacts to air quality for the different alternatives, air emissions and GHG emissions were calculated using the different parameters for each alternative provided in Chapter 3 of this SWEIS. Lead emissions were not calculated, as none of the proposed activities emit lead.

Construction Emissions

Construction emissions were calculated using anticipated dozer, backhoe, and grading activities for each of the alternatives. These activities will emit PM₁₀ and PM_{2.5} from the movement of the construction vehicles over unpaved roads. These emissions were calculated based on typical soil characteristics at SNL (EPA 2006a; EPA 2006b; and EPA 2021a), dozer and backhoe emissions factors (EPA 1998), and an assumed rate of 52.3 worker hours per acre of construction.

Table C-3 presents the emissions factors for construction.

Table C-3. Emission Rates from Construction

Air Emission	Emission Factor	Units
PM ₁₀	17.67	lb/acre disturbed
PM _{2.5}	9.38	lb/acre disturbed

Material Handling Emissions

Material handling emissions were calculated for the loading and unloading of the anticipated amount of materials generated in each of the alternatives. These calculations include the typical soil parameters for the area (NMED 2021), soil moisture content (EPA 2006b), mean wind speed (ISU 2023), and a ratio of 174,240 cubic feet of combined spoil and fill per acre. Table C-4 presents the emissions factors for material handling.

Table C-4. Emission Rates from Material Handling

Air Emission	Emission Factor	Units
PM ₁₀	8.93	lb/acre
PM _{2.5}	1.35	lb/acre

Paving Emissions

The emission rate for paving is 2.62 pounds (lb) of VOC per acre of paving (CAPCOA 2021).

Exhaust (Off-Road) Emissions

Exhaust emissions from off-road (construction) vehicles were calculated based on the operation of engines in dozers, excavators, and graders anticipated to be required for each of the alternatives. These calculations included the brake-specific fuel consumption of the engines (EPA 2021b and 40 CFR Part 98), the sulfur content of fuel (EPA 2021b), and an assumed operation rate of 52.3 hours/acre. Table C-5 presents the emissions factors for off-road exhaust.

Table C-5. Emission Rates from Off-Road Exhaust

Air Emission	Emission Factor	Units
CO	26.1	lb/acre
NO _x	139	lb/acre
PM ₁₀	4.60	lb/acre
PM _{2.5}	4.46	lb/acre

Air Emission	Emission Factor	Units
SO ₂	0.17	lb/acre
VOC	10.8	lb/acre
HAP	6.07	lb/acre
CO ₂	18,460	lb/acre
CH ₄	0.73	lb/acre
N ₂ O	0.15	lb/acre
CO ₂ e	18,522	lb/acre

Exhaust (On-Road) Emissions

Exhaust emissions from on-road vehicles were calculated based on the anticipated operation of heavy-duty trucks to transport generated spoil and required fill in the different alternatives. Due to the 30-year period under consideration, emissions factors were based on the average vehicle fleet emissions factors for 2030. These calculations included the average emission rates from heavy-duty trucks (DOT 2023), data for on-road vehicles from MOVES3 (EPA 2020a and EPA 2020b), the sulfur content of fuel (EPA 2021b), an average round trip distance of 60 miles, and an average truck capacity of 14 cubic yards. Table C-6 presents the emissions factors for on-road exhaust.

Table C-6. Emission Rates from On-Road Exhaust

Air Emission	Emission Factor	Units
CO	370	lb/acre
NO _x	8.9	lb/acre
PM ₁₀	1.4	lb/acre
PM _{2.5}	1.3	lb/acre
SO ₂	0.34	lb/acre
VOC	50	lb/acre
HAP	16.5	lb/acre
CO ₂	77,791	lb/acre
CH ₄	31.47	lb/acre
N ₂ O	6.29	lb/acre
CO ₂ e	80,453	lb/acre

Commuter Emissions

The exhaust emissions from commuting by contractors and additional staff were calculated based on the number of new SNL/NM employees and construction contractors required for each alternative. Due to the 30-year period under consideration, emissions factors were based on the average vehicle fleet emissions factors for 2030. These calculations included the average emission rates from cars and light-duty trucks (DOT 2023), data for on-road vehicles from MOVES3 (EPA 2020a and EPA 2020b), the sulfur content of fuel (EPA 2021b), an average commute of 10 miles each way, and 260 workdays per year. Table C-7 presents the emissions factors for commuter exhaust.

Table C-7. Emission Rates from Commuting

Air Emission	Emission Factor	Units
CO	30	lb/individual
NO _x	0.6	lb/individual
PM ₁₀	0.07	lb/individual
PM _{2.5}	0.07	lb/individual
SO ₂	0.04	lb/individual
VOC	2.4	lb/individual
HAP	2.9	lb/individual
CO ₂	4,078	lb/individual
CH ₄	2.39	lb/individual
N ₂ O	0.48	lb/individual
CO ₂ e	4,280	lb/individual

Coating Emissions

For any new construction, architectural coatings will be applied to protect the building elements. Coating emissions are based on the highest VOC emissions allowed by 40 CFR Part 59 and a ratio of 1 gallon of paint to cover 180 square feet (SCAQMD 2007). This results in an emissions factor of 0.012 lb of VOC per square foot of coating.

Electricity

SNL purchases electricity to provide light and power to site operations. The average GHG emissions of electrical power purchases were obtained by dividing the 2022 GHG emissions from facility energy use (minus the GHG emission from natural gas combustion) by the amount of electrical power purchased. This results in an emissions factor of 0.000357 MTCO₂e per kilowatt-hour.

Natural Gas Combustion Emissions

SNL uses natural gas to power boilers and emergency electrical engines. Air emissions are included in the baseline air emissions for the facility. GHG emissions factors for natural gas combustion are based on emission factors in the General Stationary Fuel Combustion Sources chapter of 40 CFR Part 98; Table C-8 presents these emissions factors.

Table C-8. Emission Rates from Natural Gas Usage

Air Emission	Emission Factor	Units
CO ₂	54.44	MT/MMCF
CH ₄	0.026	MT/MMCF
N ₂ O	0.031	MT/MMCF
CO ₂ e	54.50	MT/MMCF

MMCF: million cubic feet

Source: 40 CFR Part 98, Subpart C.

Petroleum Products Combustion Emissions

SNL/NM combusts petroleum products (like gasoline and diesel fuel) in its emergency electrical generators, fleet vehicles, and mobile equipment. Mobile source emissions are not included in the baseline air emissions for the facility. GHG emissions factors for the combustion of petroleum products were estimated by dividing the GHG emissions for 2022 by the total gallons of petroleum products purchased. This results in an emissions factor of 0.00769 MTCO_{2e}/gallon.

C.6.3 Description of Impact Assessment Methodologies

Key metrics presented in the air quality analysis for air emissions include (1) quantities of projected air emissions and comparisons to air quality standards, (2) quantities of projected GHG emissions, and (3) quantities of projected radiological emissions.

The potential air emissions were estimated for activities that would occur in each alternative. Any new stationary sources of air emissions could be subject to federal, state, and local air permitting regulations, potentially including Prevention of Significant Deterioration, New Source Review, National Emissions Standards for Hazardous Air Emissions, and/or New Source Performance Standards. Any new sources of air emissions or modifications that have the potential to increase air emissions at an existing source would require a New Source Review air permit. DOE/Sandia Field Operations has applied for a Title V operating permit and an operating permit with plant-wide applicability limits (PAL), and both permits are still being reviewed by the Albuquerque-Bernalillo County Air Quality Program. Since a timely Title V operating permit application was submitted, SNL/NM may continue to operate without an operating permit until the permitting authority takes a final action on the Title V operating permit application (i.e., issue or deny the Title V operating permit) or issues a PAL operating permit.

C.6.3.1 No-Action Alternative

Non-radiological air emissions and GHG emissions will vary over the period being considered. Emissions will increase from the construction of additional facilities and temporarily increase due to emissions from different construction-related activities. The air emissions (2025–2040) and GHG emissions (2025–2054) were calculated for each year; however, only the highest single year of emissions was included in the analysis for comparison to the baseline period.

The non-radiological air emissions consist of CO, NO_x, PM₁₀, PM_{2.5}, SO₂, VOC, and HAP emissions. These air emissions are generated from construction, materials handling, paving, on- and off-road exhaust, commuting, and application of coatings. The calculation of GHG emissions required inputs including additional personnel, electricity purchases, land disturbance, and fossil fuel combustion, which were provided in Chapter 3 of this SWEIS. Table C-9 shows the inputs used for calculating emissions under the No-Action Alternative.

Table C-9. Inputs for Non-Radiological Emissions Calculations in the No-Action Alternative, 2025–2040

Year	Land Acres	Building Acres	Parking Acres	Additional Commuters
2025	8.39	0.39	0.63	166
2026	1.19	0.05	0.08	42
2027	1.07	0.23	0.38	84
2028	0.75	0.11	0.18	67
2029	2.13	0.64	1.04	311
2030	2.24	0.59	0.96	296
2031	0.24	0.00	0.00	10
2032	0.24	0.00	0.00	20
2033	0.24	0.00	0.00	10
2034	0.24	0.00	0.00	10
2035	0.24	0.00	0.00	10
2036	0.24	0.00	0.00	10
2037	0.24	0.00	0.00	10
2038	0.24	0.00	0.00	10
2039	0.24	0.00	0.00	10
2040	0.24	0.00	0.00	10

Using these inputs, the annual non-radiological emission rates were calculated in tons per year, as listed in Table C-10. Lead emissions were not calculated, as none of the proposed activities in the No-Action Alternative emit lead.

Table C-10. Non-Radiological Emission Rates for the No-Action Alternative, 2025–2040 (tpy)

Year	CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	VOC	HAP
2025	4.18	0.67	0.14	0.07	0.006	0.53	0.33
2026	0.87	0.10	0.02	0.01	0.001	0.11	0.07
2027	1.49	0.10	0.02	0.01	0.002	0.18	0.13
2028	1.17	0.08	0.01	0.01	0.002	0.14	0.10
2029	5.14	0.25	0.05	0.03	0.007	0.52	0.47
2030	4.93	0.26	0.05	0.03	0.007	0.50	0.45
2031	0.20	0.02	0.00	0.00	0.000	0.02	0.02
2032	0.35	0.02	0.00	0.00	0.000	0.03	0.03
2033	0.20	0.02	0.00	0.00	0.000	0.02	0.02
2034	0.20	0.02	0.00	0.00	0.000	0.02	0.02
2035	0.20	0.02	0.00	0.00	0.000	0.02	0.02
2036	0.20	0.02	0.00	0.00	0.000	0.02	0.02
2037	0.20	0.02	0.00	0.00	0.000	0.02	0.02
2038	0.20	0.02	0.00	0.00	0.000	0.02	0.02
2039	0.20	0.02	0.00	0.00	0.000	0.02	0.02
2040	0.20	0.02	0.00	0.00	0.000	0.02	0.02

General conformity requirements apply to federal actions in air quality control regions classified as nonattainment or maintenance (if within 20 years of reclassification from nonattainment to maintenance). Since Bernalillo County, New Mexico, is designated as attainment for all National Ambient Air Quality Standards (NAAQS) and the CO maintenance attainment classification expired in 2015, 20 years after its 1995 redesignation, the general conformity standard does not apply to federal actions at SNL/NM. Table C-11 shows the highest individual year of air emissions for the No-Action Alternative. Since SNL/NM is not located in an area that is designated as nonattainment or maintenance, general conformity requirements do not apply (40 CFR Part 93 and 20.11.4 New Mexico Administrative Code [NMAC]). The CO maintenance attainment classification expired in 2015, 20 years after the 1995 redesignation.

Table C-11. Estimated Annual Emissions from the No-Action Alternative for General Conformity

Air Emissions (tpy)	Construction Emissions (tpy)	Operations Emissions (tpy)	Total Emissions (tpy)	Estimated Change from Baseline (tpy)	Subject to General Conformity?
CO	5.1	15.3	214.5	3.8	No
NO _x	0.3	18.8	25.7	9.4	No
PM ₁₀	0.05	12.1	108.6	10.4	No
PM _{2.5}	0.03	12.1	108.5	10.4	No
SO ₂	0.01	11.9	12.3	11.6	No
VOC	0.5	15.1	30.7	11.2	No
Lead	<0.1	<0.1	<0.1	0	No

Source: SNL 2018; SNL 2019; SNL 2020; SNL 2021; SNL 2022.

Greenhouse Gas Emissions

GHGs consist of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases (including sulfur hexafluoride [SF₆]). GHGs are emitted from construction operations, including on- and off-road exhaust from construction equipment, contractor commuting, and combustion of fossil fuels to generate heat and electricity during construction. Operation GHG emissions are generated from employee commuting and combustion of fossil fuels to generate additional heat and electricity. The calculation of GHG emissions for each alternative required developing emissions estimates from additional personnel, anticipated changes to electricity usage, acres of land disturbance, and fossil fuel combustion, which were provided in Chapter 3 of this SWEIS. Table C-12 includes the calculated GHG emissions using the data from Chapter 3 for the No-Action Alternative.

Table C-12. GHG Emissions in the No-Action Alternative, 2025–2054 (MT/year)

Year	CO ₂	CH ₄	N ₂ O	CO ₂ e (Construction)	CO ₂ e (Operations)
2025	742.47	0.33	0.067	771	210,239
2026	143.14	0.07	0.014	149	210,086
2027	222.76	0.12	0.024	233	210,639
2028	172.94	0.09	0.018	181	211,056
2029	736.84	0.41	0.081	771	212,115

Year	CO ₂	CH ₄	N ₂ O	CO ₂ e (Construction)	CO ₂ e (Operations)
2030	711.53	0.39	0.078	745	213,033
2031	32.16	0.02	0.003	34	212,322
2032	52.55	0.03	0.006	55	212,343
2033	32.16	0.02	0.003	34	212,322
2034	32.16	0.02	0.003	34	212,322
2035	32.16	0.02	0.003	34	212,322
2036	32.16	0.02	0.003	34	212,322
2037	32.16	0.02	0.003	34	212,322
2038	32.16	0.02	0.003	34	212,322
2039	32.16	0.02	0.003	34	212,322
2040	32.16	0.02	0.003	34	212,322

C.6.3.2 Modernized Operations Alternative

Projects and activities included in the Modernized Operations Alternative include those analyzed for the No-Action Alternative.

Non-radiological air emissions would vary over the 15-year period from 2025–2040. Emissions would increase from the construction of additional facilities and temporarily increase due to emissions from different construction-related activities. The air emissions and GHG emissions were calculated for each year; however, only the highest single year of emissions was included in the analysis for comparison to the baseline period.

The non-radiological air emissions consist of CO, NO_x, PM₁₀, PM_{2.5}, SO₂, VOC, and HAP emissions. These air emissions are generated from construction, materials handling, paving, on- and off-road exhaust, commuting, and application of coatings. Most of the factors used to calculate emissions were based on land disturbance, measured in pounds of emissions per acre, or the number of personnel (additional staff and contractors). The required inputs for calculating total emissions were the total land disturbance acreage, constructed building acreage, parking acreage, and number of personnel, which were provided in Chapter 3 of this SWEIS. Table C-13 shows the inputs used for calculating emissions under the Modernized Operations Alternative.

Table C-13. Inputs for Non-Radiological Emissions Calculations in the Modernized Operations Alternative, 2025–2040

Year	Land Acres	Building Acres	Parking Acres	Additional Commuters
2025	2.73	0.75	1.22	136
2026	4.64	1.47	2.39	314
2027	4.31	1.35	2.19	213
2028	3.48	1.03	1.69	199
2029	3.42	1.00	1.63	185
2030	2.62	0.70	1.14	131
2031	2.18	0.54	0.88	98
2032	3.47	0.86	1.40	164
2033	4.19	1.13	1.84	312
2034	4.96	1.60	2.60	388

Year	Land Acres	Building Acres	Parking Acres	Additional Commuters
2035	8.11	2.80	4.55	582
2036	4.12	1.28	2.09	234
2037	4.51	0.25	0.41	56
2038	3.86	0.00	0.00	10
2039	3.86	0.00	0.00	10
2040	3.86	0.00	0.00	10

Using these inputs, the annual non-radiological emission rates were calculated in tons per year, as listed in Table C-14. Lead emissions were not calculated, as none of the proposed activities in the Modernized Operations Alternative emit lead.

Table C-14. Non-Radiological Emission Rates for the Modernized Operations Alternative, 2025–2040 (tpy)

Year	CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	VOC	HAP
2025	2.60	0.24	0.05	0.03	0.004	0.33	0.23
2026	5.68	0.44	0.09	0.05	0.008	0.64	0.50
2027	4.08	0.38	0.08	0.04	0.006	0.50	0.36
2028	3.71	0.32	0.06	0.04	0.005	0.45	0.33
2029	3.48	0.31	0.06	0.03	0.005	0.43	0.30
2030	2.51	0.23	0.05	0.03	0.003	0.32	0.22
2031	1.92	0.19	0.04	0.02	0.003	0.26	0.17
2032	3.18	0.31	0.06	0.03	0.004	0.40	0.28
2033	5.56	0.41	0.08	0.05	0.008	0.61	0.50
2034	6.87	0.49	0.09	0.05	0.010	0.74	0.61
2035	10.44	0.78	0.15	0.09	0.014	1.11	0.93
2036	4.37	0.38	0.08	0.04	0.006	0.52	0.38
2037	1.74	0.35	0.08	0.04	0.002	0.26	0.13
2038	0.92	0.29	0.06	0.03	0.001	0.14	0.06
2039	0.92	0.29	0.06	0.03	0.001	0.14	0.06
2040	0.92	0.29	0.06	0.03	0.001	0.14	0.06

Table C-15 shows the highest individual year of air emissions for the Modernized Operations Alternative. Since SNL/NM is not located in an area that is designated as nonattainment or maintenance, general conformity requirements do not apply (40 CFR Part 93 and 20.11.4 NMAC). The CO maintenance attainment classification expired in 2015, 20 years after the 1995 redesignation.

Table C-15. Estimated Annual Emissions from the Modernized Operations Alternative for General Conformity

Air Emissions (tpy)	Construction Emissions (tpy)	Operations Emissions (tpy) ^a	Total Emissions (tpy)	Estimated Change from Baseline (tpy)	Subject to General Conformity?
CO	10.4	263.4	273.8	50.7	No
NO _x	0.78	53.5	54.3	28.9	No
PM ₁₀	0.15	121.5	121.6	13.1	No

Air Emissions (tpy)	Construction Emissions (tpy)	Operations Emissions (tpy) ^a	Total Emissions (tpy)	Estimated Change from Baseline (tpy)	Subject to General Conformity?
PM _{2.5}	0.09	121.4	121.5	13.1	No
SO ₂	0.014	24.7	24.7	12.4	No
VOC	1.11	52.0	53.2	21.5	No
Lead	<0.1	<0.1	<0.1	0	No

a. This is the sum of the stationary, ordinance, and commuting emissions.

Source: SNL 2018; SNL 2019; SNL 2020; SNL 2021; and SNL 2022.

Greenhouse Gas Emissions

GHGs consist of CO₂, CH₄, N₂O, and fluorinated gases (including SF₆). GHGs are emitted from construction operations, including on- and off-road exhaust from construction equipment, contractor commuting, and combustion of fossil fuels to generate heat and electricity during construction. Operation GHG emissions are generated from employee commuting and combustion of fossil fuels to generate additional heat and electricity. The calculation of GHG emissions for each alternative required developing emissions estimates based on the number of personnel (additional staff and contractors), anticipated electricity usage, acres of land disturbance, and additional fossil fuel combustion, which were provided in Chapter 3 of this SWEIS. Table C-16 includes the calculated GHG emissions using the data from Chapter 3 for both the No-Action and Modernized Operations Alternatives.

Table C-16. GHG Emissions in the Modernized Operations Alternative, 2025–2054 (MT/year)

Year	CO ₂	CH ₄	N ₂ O	CO ₂ e (Construction)	CO ₂ e (Operations)
2025	408.67	0.21	0.041	426	224,825
2026	863.52	0.45	0.090	902	225,904
2027	641.71	0.32	0.065	669	226,275
2028	573.22	0.29	0.059	598	226,807
2029	541.78	0.28	0.055	565	227,377
2030	393.18	0.20	0.040	410	227,826
2031	304.73	0.15	0.030	318	228,136
2032	501.61	0.25	0.050	523	228,745
2033	838.10	0.44	0.088	875	229,501
2034	1029.87	0.54	0.109	1,076	230,105
2035	1577.26	0.83	0.165	1,647	231,079
2036	675.62	0.35	0.069	705	230,540
2037	331.58	0.14	0.028	343	230,582
2038	206.27	0.07	0.015	213	230,854
2039	206.27	0.07	0.015	213	231,258
2040	206.27	0.07	0.015	213	231,661

C.6.3.3 Expanded Operations Alternative

Projects and activities included in the Expanded Operations Alternative include those analyzed for the Modernized Operations Alternative and No-Action Alternative.

Non-radiological criteria air emissions would vary over the 30-year period from 2025–2054. Emissions would increase from the construction of additional facilities and temporarily increase due to emissions from different construction-related activities. The air emissions (2025–2040) and GHG emissions (2025–2054) were calculated for each year; however, only the highest single year of emissions was included in the analysis for comparison to the baseline period.

The non-radiological air pollutants consist of CO, NO_x, PM₁₀, PM_{2.5}, SO₂, VOC, and HAP emissions. These air emissions are generated from construction, materials handling, paving, on- and off-road exhaust, commuting, and application of coatings. Most of the factors used to calculate emissions were based on land disturbance, measured in pounds of emissions per acre, or the number of personnel (additional staff and contractors). The required inputs for calculating total emissions were the total land disturbance acreage, constructed building acreage, parking acreage, and personnel, which were provided in Chapter 3 of this SWEIS. Table C-17 presents the inputs used for calculating emissions under the Expanded Operations Alternative.

Table C-17. Inputs for Non-Radiological Emissions Calculations in the Expanded Operations Alternative, 2025–2040

Year	Land Acres	Building Acres	Parking Acres	Additional Commuters
2025	278.07	0.06	0.10	46
2026	279.21	0.49	0.81	146
2027	279.58	0.62	1.02	174
2028	271.75	0.19	0.31	64
2029	271.75	0.20	0.33	56
2030	17.32	0.11	0.18	36
2031	18.41	0.52	0.85	135
2032	20.51	1.33	2.16	309
2033	24.27	2.76	4.49	940
2034	23.12	2.32	3.78	845
2035	23.24	2.37	3.86	845
2036	4.74	1.21	1.97	392
2037	8.44	1.38	2.25	339
2038	7.24	0.92	1.50	229
2039	4.83	0.00	0.00	10
2040	4.83	0.00	0.00	10

Using these inputs, the annual non-radiological emission rates were calculated in tons per year, as listed in Table C-18. Lead emissions were not calculated, as none of the proposed activities in the Expanded Operations Alternative emit lead.

Table C-18. Non-Radiological Emission Rates for the Expanded Operations Alternative, 2025–2040 (tpy)

Year	CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	VOC	HAP
2025	55.73	20.62	4.51	2.29	0.072	8.96	3.20
2026	57.48	20.73	4.53	2.31	0.074	9.16	3.36
2027	57.97	20.77	4.54	2.31	0.075	9.21	3.41
2028	54.76	20.15	4.41	2.24	0.071	8.80	3.16
2029	54.63	20.15	4.41	2.24	0.071	8.79	3.15
2030	3.97	1.29	0.28	0.14	0.005	0.63	0.25
2031	5.69	1.41	0.30	0.16	0.008	0.82	0.40
2032	8.75	1.61	0.34	0.18	0.012	1.13	0.68
2033	19.06	2.08	0.43	0.23	0.026	2.05	1.63
2034	17.39	1.97	0.40	0.22	0.024	1.89	1.48
2035	17.42	1.98	0.41	0.22	0.024	1.90	1.48
2036	6.88	0.47	0.09	0.05	0.010	0.72	0.62
2037	6.81	0.73	0.15	0.08	0.009	0.79	0.58
2038	4.91	0.61	0.13	0.07	0.007	0.60	0.41
2039	1.11	0.36	0.08	0.04	0.001	0.17	0.07
2040	1.11	0.36	0.08	0.04	0.001	0.17	0.07

Table C-19 shows the highest individual year of air emissions for the Expanded Operations Alternative. Since SNL/NM is not located in an area that is designated as nonattainment or maintenance, general conformity requirements do not apply (40 CFR Part 93 and 20.11.4 NMAC). The CO maintenance attainment classification expired in 2015, 20 years after the 1995 redesignation.

Table C-19. Estimated Annual Emissions from the Expanded Operations Alternative for General Conformity

Air Emissions (tpy)	Construction Emissions (tpy)	Operations Emissions (tpy) ^a	Total Emissions (tpy)	Estimated Change from Baseline (tpy)	Subject to General Conformity?
CO	58.0	314.8	372.8	102.1	No
NO _x	20.8	65.3	86.1	40.7	No
PM ₁₀	4.5	170.4	174.9	62.0	No
PM _{2.5}	2.3	170.4	172.7	62.0	No
SO ₂	0.08	25.3	25.3	13.0	No
VOC	9.19	60.0	69.3	29.5	No
Lead	<0.1	<0.1	<0.1	0	No

a. This is the sum of the stationary, ordinance, and commuting emissions.

Source: SNL 2018; SNL 2019; SNL 2020; SNL 2021; and SNL 2022.

Greenhouse Gas Emissions

GHGs consist of CO₂, CH₄, N₂O, and fluorinated gases (including SF₆). GHGs are emitted from construction operations, including on- and off-road exhaust from construction equipment, contractor commuting, and combustion of fossil fuels to generate heat and electricity during construction. Operation GHG emissions are generated from employee commuting and combustion of fossil fuels to generate additional heat and electricity. The calculation of GHG emissions for each alternative required developing emissions estimates from additional personnel, anticipated changes to electricity usage, acres of land disturbance, and fossil fuel combustion, which were provided in Chapter 3 of this SWEIS. Table C-20 includes the calculated GHG emissions using the data from Chapter 3 for the No-Action, Modernized Operations, and Expanded Operations Action Alternatives.

Table C-20. GHG Emissions from Construction in the Expanded Operations Alternative, 2025–2054 (MT/year)

Year	CO ₂	CH ₄	N ₂ O	CO ₂ e (Construction)	CO ₂ e (Operations)
2025	13,476.13	4.53	0.907	13,860	246,787
2026	13,734.88	4.67	0.934	14,130	248,056
2027	13,809.53	4.71	0.942	14,208	249,132
2028	13,208.59	4.45	0.891	13,585	249,508
2029	13,192.28	4.44	0.889	13,568	250,490
2030	906.97	0.32	0.064	934	183,494
2031	1,161.28	0.46	0.092	1,200	184,550
2032	1,617.11	0.70	0.140	1,676	186,174
2033	3,084.40	1.52	0.303	3,213	188,393
2034	2,835.60	1.38	0.277	2,953	188,816
2035	2,841.14	1.39	0.277	2,958	189,505
2036	1,027.30	0.55	0.109	1,073	188,303
2037	1,097.54	0.54	0.108	1,143	189,056
2038	815.27	0.39	0.078	848	189,444
2039	252.77	0.09	0.018	260	189,539
2040	252.77	0.09	0.018	260	190,222

C.7 NOISE

C.7.1 Description of Affected Resources and Region of Influence

This appendix describes the methodologies and analyses for assessing noise impacts used to complete Chapter 4, Section 4.7, and Chapter 5, Section 5.7, of this SWEIS. All analyses considered current and proposed activities over the next 15 years (2025–2040). The ROI for this analysis comprises SNL/NM, KAFB, adjacent locations, including residential areas and the La Semilla buffer zone, and offsite locations within the state of New Mexico for conducting activities related to unmanned systems (UxS).

C.7.2 Description of Impact Analysis

Impacts from noise generation were estimated using the inverse square law, since the pressure of a sound wave decreases inversely with the square of the distance between the source and the receptor (DoD 2017). The distance from potential worksites to the closest residential areas was determined. Typical noise levels at 50 feet from construction equipment are provided in Table C-21.

Table C-21. Average and Typical Noise Levels from Common Construction Equipment

Equipment	Average Noise Level (dBA) 50 feet	Typical Noise Level (dBA) 50 feet	Maximum Noise Level (dBA) 50 feet
Air Compressor	85	81	85
Backhoe	83	80	83
Compactor	Unavailable	82	82
Compressor	85	Unavailable	85
Concrete Mixer	Unavailable	85	85
Concrete Pump	Unavailable	82	82
Concrete Truck	81	Unavailable	81
Concrete Vibrator	Unavailable	76	76
Crane, Derrick	87	88	88
Crane, Mobile	87	83	87
Dozer	84	85	85
Drill Rig	88	Unavailable	88
Dump Truck	84	Unavailable	84
Generator	78	81	81
Gradall	86	Unavailable	86
Grader	Unavailable	85	85
Hoe Ram	85	Unavailable	85
Impact Wrench	Unavailable	85	85
Jackhammer	89	88	89
Loader	86	85	86
Paver	Unavailable	89	89
Pile Driver, Impact	101	101	101
Pile Driver, Sonic	Unavailable	96	96
Pump	Unavailable	85	85
Rock Drill	Unavailable	98	98
Roller	Unavailable	74	74
Scraper	Unavailable	89	89
Slurry Machine	91	Unavailable	91
Truck	85	88	88

dBA: A-weighted decibel (noise).

Source: FHWA 2017.

Using the inverse square law, the noise impacts from construction equipment were estimated for the closest residential areas. This methodology was completed for the No-Action, Modernized Operations, and Expanded Operations Alternatives.

C.8 BIOLOGICAL RESOURCES

C.8.1 Description of Affected Resources and Region of Influence

The affected biological resources include vegetation, wildlife, federally and state-listed protected and sensitive species, and wetlands at SNL/NM. The ROI for biological resources consists of the SNL/NM and KAFB sites and adjacent areas. This SWEIS presents information compiled from SNL/NM Environmental Systems Department Ecology Program Annual Data Reports, NNSA Management Plans, Annual Site Environmental Reports, KAFB Natural Resources and Environmental Services Reports, and other publications and reports.

C.8.2 Description of Impact Assessment

Key metrics in this analysis include (1) identification of disturbances to land/vegetation and discussion of impacts on habitats, wildlife, and protected and special status species and (2) identification and discussion of wetland impacts. This SWEIS evaluates the projects/actions based on the amount of disturbance that may affect the biological resources of the ROI. These impacts were evaluated based on the degree to which various habitats or species could be affected relative to the existing Affected Environment. Impacts were evaluated mainly qualitatively rather than quantitatively. Where appropriate, impacts were evaluated against federal and state protection regulations and standards. Impacts, if any, are evaluated and a determination made as to severity.

C.8.2.1 Vegetation

Potential impacts on vegetation were evaluated by comparing data on site vegetation to land requirements and locations of construction and operational activities of the alternatives. Changes to the existing vegetation and already disturbed sites proposed for redevelopment were evaluated.

C.8.2.2 Wildlife

Potential impacts on wildlife were based primarily on the degree of habitat changes proposed due to the activities involving clearing of vegetation for construction and operation of facilities. The availability of suitable habitat adjacent to the construction activities, as well as types of construction, were considered when evaluating potential impacts to wildlife over the short and long term. The historical and recent documentation of wildlife within habitats in the ROI was considered, including occurrence or potential occurrence of sensitive and protected species in the proposed construction sites. Quantitative data were used when available for documentation of declines and the presence or absence of species in different habitat types throughout the ROI.

C.8.2.3 Protected and Sensitive Species

As with wildlife considerations, the occurrence and potential occurrence of federally and state-listed, protected, and sensitive species in the ROI were evaluated and impacts considered under the various alternatives. The U.S. Fish and Wildlife Service Information for Planning and

Consultation website (<https://www.fws.gov/service/information-planning-and-consultation>) was used to determine the potential occurrence of federally listed and sensitive species. Designated critical habitat is not currently present within the ROI, and species listed as threatened or endangered under the Endangered Species Act are not currently expected in the ROI due to this lack of suitable habitat.

C.8.2.4 Wetlands

Potential impacts on wetlands were generally based on the same approach taken for vegetation and wildlife considerations. The assessment of direct impacts considered the amount of wetlands and waters of the United States that would be impacted by the construction and operational activities.

C.9 CULTURAL AND PALEONTOLOGICAL RESOURCES

C.9.1 Description of Affected Resources and Region of Influence

This SWEIS analyzes cultural resources within an ROI comprising SNL/NM (lands owned by DOE, all KAFB lands permitted to SNL/NM for laboratory missions, and all U.S. Department of Agriculture Forest Service and BLM lands withdrawn from the public domain for laboratory missions), KAFB, and adjacent locations. Cultural resources are divided into three general categories for this SWEIS: archaeological resources (prehistoric), archaeological resources (historic), and historic structures. A fourth category is tribal resources (traditional cultural places [TCPs]). Several TCPs and their locations have been shared by tribes on lands managed by SNL/NM. These locations and TCPs are treated as eligible resources and are protected. However, it should be noted that tribes often consider natural resources, such as mountains, wetlands, viewsheds, springs, and prominent geologic features, to be TCPs. Impacts to these natural resources are considered elsewhere in this SWEIS. All cultural resources are organized by eligibility for the National Register of Historic Places (NRHP) (36 CFR Part 60): (1) the historic properties have been determined eligible for listing in the NRHP, (2) the historic properties are unevaluated and are managed as eligible properties until determined otherwise, and (3) the historic properties have been determined not eligible for listing in the NRHP, but are considered in the analysis under the “hard look” provisions of NEPA.

Historical properties are evaluated for inclusion in the NRHP using four criteria specified in 36 CFR 60.4, which states:

The quality of significance in American history, architecture, archeology [sic], engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

- A. That are associated with events that have made a significant contribution to the broad patterns of our history; or
- B. That are associated with the lives of persons significant in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded, or may be likely to yield, information important in prehistory or history.

Specific to SNL/NM, the Criteria Consideration G exception is applied. This exception allows for properties not yet 50 years old to be considered if they have achieved exceptional historical significance and/or they are part of a historic district that qualifies under Criteria A and C.

Section 106 of the National Historic Preservation Act (Title 54 of the *United States Code* [U.S.C.] § 300101 et seq.) and its implementing regulations (36 CFR Part 800) state that an undertaking has an effect on a significant historic property when that undertaking may alter those characteristics of the property that qualify it for inclusion in the NRHP. An undertaking is considered to have an adverse effect when it diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects include, but are not limited to:

- physical destruction, damage, or alteration of all or part of the property;
- removal of a property from its historic location;
- change to the character of the property's use or of physical features in its setting when that character contributes to the property's historic significance;
- introduction of visual, audible, or atmospheric elements that are out of character with the property, or changes that alter its setting;
- neglect of a property resulting in its deterioration or destruction; or
- transfer, lease, or sale of a property out of federal ownership without adequate provisions to protect the property's historic integrity.

Paleontological resources are the fossil remains of past life forms where once-living organisms, such as plants, animals, fungi, and bacteria, have been replaced by minerals. Fossils also include imprints or traces of organisms preserved in rock. Paleontological resources are considered a fragile and nonrenewable scientific record of the history of life on Earth, and as such represent an important component of America's natural heritage. Paleontological resources have not been identified within the ROI considered in this SWEIS, and they are not considered further in this analysis.

C.9.2 Description of Impact Assessment

The key metrics for the cultural resources analysis include (1) a quantitative analysis of the extent of ground disturbances with the assumption that there is greater potential for adverse effects to archaeological resources (both prehistoric and historic) when previously undisturbed lands are developed and (2) a qualitative analysis of the potential to directly impact cultural

resources through ground-disturbing activities, such as the deactivation, decontamination, and demolition of historic properties that removes them from the historic landscape, and the potential to indirectly impact cultural resources, such as the introduction of visual, audible, or atmospheric elements out of character with the property or that change its historic setting. Existing federal and state laws and regulations, as well as DOE policy, mandate consultation with the New Mexico State Historic Preservation Office and relevant tribes to avoid, minimize, or mitigate adverse effects prior to development.

C.10 TRAFFIC AND TRANSPORTATION

C.10.1 Description of Affected Resources and Region of Influence

The ROI for transportation is SNL/NM, KAFB, adjacent areas, and the corridors between SNL/NM and other sites where radiological and hazardous material transportation could occur. For the existing environment, the SWEIS describes the transportation infrastructure (road network, mass transit, and ride sharing) used by workers for commuting. The level of service on area roads is presented to describe operational conditions as they relate to traffic streams and the perceptions of motorists and passengers. The existing circulation and transportation network within the SNL/NM site area is described, as well as parking conditions. The description of the existing environment also includes a discussion of the transport of radiological materials/wastes and non-radiological hazardous materials/waste shipments between SNL/NM and other sites.

C.10.2 Description of Impact Assessment

Key metrics presented in the traffic and transportation analysis include (1) traffic changes on area roads and (2) impacts to the public and transport crews from shipments of radiological and hazardous materials. The analysis of non-radiological/non-hazardous transportation impacts used workforce estimates to evaluate the impact of commuting workers on the level of service of area roads. Within the SNL/NM site area, the analysis focused on the impact of workforce changes on circulation and parking.

Because the SWEIS alternatives involve offsite transport of radiological materials/wastes and non-radiological hazardous materials/waste shipments between SNL/NM and other sites, the analysis addressed the impacts of transporting these types of materials/wastes. For this analysis, NNSA determined the types and quantities of materials/wastes that would be transported, as well as the origins and destinations of the shipments. Impacts were calculated for anticipated incident-free (or routine) transportation, as well as for postulated transportation accidents.

For transportation accidents, the analysis presents both radiological and non-radiological impacts. Radiological impacts from accident conditions consider foreseeable scenarios that could damage transportation packages, leading to releases of radioactive materials to the environment, and are expressed in terms of LCFs to potentially exposed nearby populations and to a hypothetical maximally exposed public receptor. The radiological risks from the routine (i.e., incident-free) transportation of materials and wastes are likewise estimated in terms of the number of LCFs, both among shipping crews and exposed populations. Non-radiological impacts are expressed in terms of traffic fatalities and are determined by multiplying the number of miles

to be driven, based on the number of shipments, by estimated route-specific fatality rates. Appendix E presents more details of the methodology for offsite transport of radiological materials/wastes and non-radiological hazardous materials/waste shipments.

C.11 INFRASTRUCTURE

C.11.1 Description of Affected Resources and Region of Influence

Potentially affected site infrastructure resources include electrical distribution systems, natural gas, fuel, domestic water, and sanitary sewer systems. The ROI includes the land and resource areas within SNL/NM and KAFB.

C.11.2 Description of Impact Assessment

Key metrics presented in the infrastructure analysis are (1) quantities of water, sanitary sewer (wastewater), electricity, and fuel (petroleum and natural gas) associated with construction, deactivation, decontamination, and demolition, modernization/upgrade/utility projects, and operations and (2) analysis of the current infrastructure's ability to meet demands. The SWEIS assessment of potential impacts to site infrastructure focused on the ability of the site to support the alternatives. Based on estimated requirements for the alternatives, the Campus Master Plan, and other DOE/NNSA planning documents, infrastructure requirements were projected over the planning periods for the alternatives. The analysis identified significant demands and potential impacts to the existing infrastructure from implementation of the alternatives.

C.12 MATERIALS MANAGEMENT AND WASTE MANAGEMENT

C.12.1 Description of Affected Resources and Region of Influence

Affected resources in this discussion are the SNL/NM site processes and facilities currently in place to manage (treat, store, and dispose of) waste. The ROI consists of the SNL/NM site and any offsite facilities where SNL/NM waste is sent for management. The SNL/NM waste streams considered in this case include the following:

- radioactive waste
 - low-level radioactive waste (LLW),
 - mixed low-level radioactive waste (MLLW), and
 - transuranic (TRU) waste, including mixed TRU waste;
- hazardous waste, including explosives waste;
- polychlorinated biphenyls (PCBs);
- New Mexico Special Waste;
- biohazardous/medical waste;
- commercial solid waste; and
- construction and demolition waste.

The emphases for the affected resources are those waste types and quantities that are currently generated within SNL/NM and that would be generated under the three alternatives. The

description of affected resources consists of a brief discussion of each waste type that includes typical characteristics of the waste involved, the amount generated per year, and the way it is managed. Waste management actions or processes are described in terms of throughput and capacity to the extent possible. They are also evaluated to identify any regulatory or permit issues (e.g., throughput limitations, violations, adverse findings) indicating that adverse environmental impacts could be associated with additional waste generation.

C.12.2 Description of Impact Assessment

Key metrics for the waste analysis include (1) the capacity of the existing SNL/NM waste management system to appropriately manage any expected increases in waste quantities and (2) the capacity of offsite facilities to receive additional SNL/NM waste for subsequent treatment and/or disposal.

Potential impacts associated with waste management are evaluated based on the waste types and estimated volumes that would be generated by the three alternatives. Waste types were evaluated to determine if they are consistent with existing SNL/NM waste streams and appropriate for management under the same procedures and processes as used for similar waste streams. Projections of waste volumes from the three alternatives were each compared to the routine waste generation within SNL/NM to determine if procedures, processes, or infrastructure capacity could possibly be overwhelmed by the additional waste loads.

SNL/NM employs several types of waste treatment processes within the SNL/NM site. SNL/NM's waste treatment is intended to make the waste suitable for offsite disposal or to reduce its volume to make offsite treatment or disposal more efficient. Accordingly, a key element of evaluating the impact of managing SNL/NM waste is considering how offsite treatment and disposal facilities might be affected. Two DOE facilities, the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, and the Nevada Nuclear Security Site, are identified as disposal sites for SNL/NM TRU and LLW/MLLW, respectively. The analysis focused on how increased waste quantities associated with the three alternatives could impact disposal capacities and ongoing waste receipt operations. The reasonably foreseeable effects analysis in Chapter 6 of this SWEIS addresses long-term impacts associated with potential impacts to the WIPP's capacity and planned life span.

C.13 HUMAN HEALTH AND SAFETY

C.13.1 Description of Affected Resources and Region of Influence

Potential impacts on public and worker health and safety include radiological and non-radiological exposure pathways and occupational injuries, illnesses, and fatalities resulting from construction activities and normal (accident-free) operations for the alternatives. Exposure pathways include inhalation, immersion, ingestion, and exposure to external sources. Occupational ROIs include involved and non-involved workers. The ROI for human health and safety is the SNL/NM site and offsite areas within a 50-mile radius of the site due to potential release of materials to the environment.

Because operations at SNL/NM have the potential to release radionuclides to the environment that result in exposure to the worker and the public, DOE/NNSA conducts environmental surveillance and monitoring activities at SNL/NM and surrounding areas. These activities provide data that are used to evaluate potential radiation exposures that may contribute doses to the public. Each year, environmental data from SNL/NM are collected and analyzed. The results of these environmental monitoring activities are summarized in the Annual Site Environmental Reports. The environmental monitoring conducted at SNL/NM consists of two major activities: effluent monitoring and environmental surveillance.

Effluent monitoring involves the collection and analysis of samples or measurements of liquid (waterborne) and gaseous (airborne) effluents prior to release into the environment. These analytical data provide the basis for the evaluation and official reporting of contaminants, assessment of radiation and chemical exposures to the workers and the public, and demonstration of compliance with applicable standards and permit requirements.

Environmental surveillance data directly measure contaminants in air, water, groundwater, soil, food, biota, and other media subsequent to effluent release into the environment. These data verify SNL/NM's compliance status and combined with data from effluent monitoring, allow the determination of chemical and radiation dose and exposure assessment of DOE/NNSA operations and effects, if any, on the local environment. The effluent and environmental surveillance data presented in the environmental reports were used as the primary source of data for the analysis of radiation exposure to the public for the No-Action Alternative.

C.13.2 Description of Impact Assessment

Key metrics presented in the human health analysis are (1) radiological doses and potential LCFs to the public and workers from normal operations, (2) occupational injuries/deaths to workers, and (3) health impacts to workers and the public from normal operations involving chemical and biological materials. The SWEIS also includes an analysis of Special Pathways – Subsistence Consumption of Fish and Wildlife, which assess the potential impacts to tribal and other residents whose traditional living habits and diets could potentially cause larger exposures to environmental contaminants than those experienced by the hypothetical offsite resident. A summary of the methodology used to assess the human health impacts during normal operations is presented in this section. Appendix D documents additional details.

Radiological impacts were assessed for workers involved in SNL/NM operations and for the public (maximally exposed individual [MEI] and population within the 50-mile radius of the site). Estimates of health impacts to the MEI and population are based on doses calculated by the radiological air analyses. Radiological doses were calculated for the MEI and the entire population residing within 50 miles of the SNL/NM site. The analysis calculated doses from normal operations using the U.S. Environmental Protection Agency (EPA)-mandated air

dispersion dose model, CAP88-PC Version 4.1.1.¹ The CAP88 dose model was developed under EPA sponsorship to demonstrate compliance with 40 CFR Part 61, Subpart H, which governs the emissions of radionuclides other than radon from DOE facilities.

Meteorological data used in the calculations were in the form of joint frequency distributions of wind direction, wind speed class, and atmospheric stability category. For occupants of residences within the ROI, the dose calculations assumed that the occupant remained at home (unprotected outside the house) during the entire year and obtained food according to the rural pattern defined in the background documents for the National Emission Standards for Hazardous Air Emissions. For workers, radiological doses were estimated by DOE/NNSA based on historical dose information.

Occupational injury, illness, and fatality estimates were evaluated using occupational incidence rates of major industry groups based on U.S. Department of Labor, Bureau of Labor Statistics, injury, illness, and fatality information for similar activities (BLS 2024). These rates were compared to person-hour estimates for the alternatives. Occupational injury, illness, and fatality categories used in this analysis are in accordance with Occupational Safety and Health Administration definitions. Incident rates were developed for facility construction and operations.

Facility operations were evaluated to determine if any chemical-related or biological-related health impacts would be associated with normal (accident-free) operations. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection is augmented by programs such as the Integrated Safety Management System, an environmental management system, an operational health and safety management system, a worker safety and health program, work planning and control documents, chemical hygiene, monitoring by industrial hygiene personnel, and emergency preparedness.

C.14 SOCIOECONOMICS

C.14.1 Description of Affected Resource and Region of Influence

The term “socioeconomics” refers to the attributes of the human environment, particularly the demographic and economic characteristics. The demographics of the socioeconomic ROI refers to the characteristics of the population within that specific area. This typically includes variables such as population, age, earnings, education, employment, health, housing, income and poverty, and services. This analysis considers the attributes of human social and economic interactions of a proposed action and alternative and the impacts such actions may have on the ROI.

¹ CAPP88-PC Version 4.1.1 is available on the EPA website at <https://www.epa.gov/radiation/forms/cap88-pc-version-411-downloads-and-supporting-documents>.

The socioeconomic ROI is defined as the area in which the principal direct and secondary socioeconomic effects of the proposed actions and alternatives are likely to occur and includes most of the residential distribution of SNL/NM personnel. In 2022, approximately 83 percent of SNL/NM personnel resided in Bernalillo County and another 17 percent resided in surrounding counties. Since the majority of SNL/NM workforce resided in Bernalillo County, the ROI for this analysis is Bernalillo County.

C.14.2 Description of Impact Assessment

Key metrics presented in the socioeconomics analysis are (1) employment and population changes, (2) changes in economic activity (e.g., earnings/monetary value added), and (3) impacts to housing and community services (4) disproportionate and adverse impacts on human health or populations. A disproportionate and adverse impact refers to an impact or risk of an impact on the natural or physical environment in an at-risk population in the socioeconomic ROI that appreciably exceeds the environmental impact on the general population of New Mexico. Such effects may include ecological, cultural, human health, economic, or social impacts.

Estimates of the potential impacts on economic output, employment, and earnings under each alternative were derived using multipliers from the Regional Input-Output Modeling System (RIMS II) developed by the U.S. Bureau of Economic Analysis (BEA) for a select region (BEA 2023). Multipliers were developed for an aggregation socioeconomic ROI. The BEA develops RIMS II multipliers using input-output tables that show the distribution of inputs purchased and outputs sold for each industry. A national input-output table, representing about 500 different industries, is adjusted using BEA regional economic accounts to accurately reflect the structure of a given area.

Data from the U.S. Census Bureau, particularly the 2018–2022 American Community Survey, and state and local government data are often used to describe baseline socioeconomic characteristics. Other data sources include the U.S. Bureau of Labor Statistics, BEA, state economic development agencies, local government agencies, chamber of commerce records, and private organizations that operate as data brokers.

The projected labor force for the socioeconomic ROI was determined using historical growth rate data from a 10-year period (2012–2022) (BLS 2023). An annual growth rate of 0.48 percent from this period was calculated and applied to the 2022 baseline labor force for the ROI to estimate the projected labor force through 2040. This methodology provides a conservative approach to forecasting future labor force trends based on historical growth rates.

The impacts analysis examined potential impacts to employment, population, and local economic conditions. The value added from the direct economic activity to the local economy includes employee compensation, tax on production and imports, and proprietary and other property income and indirect employment compensation. The analysis considered vacant housing units in the ROI to determine whether an influx of workers/families into the ROI would affect housing availability. The analysis also considered potential effects on fire protection, police protection, and medical services and estimated the effects on schools. Generally, effects that result in greater

employment or income, or that otherwise improve the quality of life for the local population, are considered beneficial socioeconomic impacts.

The analysis considered potential impacts to groups within the general population that may be more vulnerable to environmental impacts based on the factors of income, age, language, and educational attainment. This assessment considers impacts to tribes and tribal trust assets and whether they experience impacts to their unique socioeconomic systems, lifestyles and resources. The process of assessing a project's potential impacts on at-risk populations involves identifying vulnerable populations and then determining whether the project's potential effects would have a disproportionate and adverse impact on these populations. Potentially disproportionate and adverse impacts on at-risk populations resulting from the Proposed Action and alternatives were evaluated using the conclusions drawn by the resource analyses presented in Chapter 5.

Disproportionate and adverse health effects are measured in risks and rates that could result in latent cancer fatalities (LCFs) and other fatal or non-fatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionate and adverse human health effects occur when the risk or rate of exposure to at-risk populations appreciably exceeds the risk or exposure rate for the general population.

C.15 REFERENCES

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APPENDIX D
**HUMAN HEALTH, SAFETY, ACCIDENTS, INTENTIONAL
DESTRUCTIVE ACTS, AND EMERGENCY MANAGEMENT**

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Appendix D – Human Health, Safety, Accidents, Intentional Destructive Acts, and Emergency Management

The purpose of this appendix is two-fold: (1) to discuss the environment, safety, and health (ES&H) programs at Sandia National Laboratories/New Mexico (SNL/NM) and (2) to support the sections in Chapters 4 and 5 of this site-wide environmental impact statement (SWEIS) related to health and safety (Sections 4.13 and 5.13) and accident analyses and intentional destructive acts (IDAs) (Section 5.14).

Section D.1 discusses the ES&H programs at SNL/NM, regulatory requirements for ES&H, and the responsibilities to address ES&H requirements. Section D.2 discusses occupational exposures/impacts from radiation, chemicals, and other industrial hazards arising from the normal operations of facilities. Section D.2 also describes environmental monitoring programs and the impact of releases of radioactive and hazardous materials from normal plant operations. The potential impacts to workers and members of the general public from hypothetical accidents are discussed in Section D.3 (note that transportation accidents are discussed in Appendix E of this SWEIS). Section D.4 discusses IDAs, and Section D.5 addresses emergency management.

D.1 ES&H PROGRAMS AND REGULATORY REQUIREMENTS

SNL/NM policies commit SNL/NM to comply with all ES&H requirements, including laws, regulations, and other related requirements such as U.S. Department of Energy (DOE) orders. In accordance with DOE Order 440.1B, Change 4 (DOE 2022a), and DOE Order 450.2, Change 1 (DOE 2017), operations at SNL/NM must be conducted in a manner that protects the health and safety of workers and the public, preserves the quality of the environment, and prevents property damage. In addition, DOE Order 452.3 (DOE 2005), requires SNL/NM operations to comply with applicable ES&H laws, regulations, and requirements and with directives promulgated by the National Nuclear Security Administration (NNSA) and DOE regarding occupational safety and health. DOE Order 458.1 (DOE 2020a) directs DOE facilities to keep radiological doses to the public and the environment as low as reasonably achievable (ALARA) and to monitor for routine and non-routine releases of radioactive materials. DOE Order 458.1 requires DOE sites to do the following:

- Ensure that the radiological dose to the public from site activities does not exceed 100 millirem (mrem) in any given year.
- Comply with the order's dose limits for wildlife and plants.
- Notify the public about any radiation doses resulting from operations.

- Use radiological limits authorized by DOE to evaluate property that has the potential to contain residual radioactivity before releasing it to ensure that the dose does not exceed 25 mrem per year above background for real property or 1 mrem per year above background for personal property.

Radiation Dose Measurement and Latent Cancer Fatalities

In this SWEIS, radiation doses are measured in units of either “person-rem” or “rem.”

Rem is used to measure the radiation dose for a single individual; 1,000 mrem equals 1 rem.

Person-rem is used to measure the total collective radiation dose for a group of people. To determine the population dose, this SWEIS sums up the individual doses.

Latent Cancer Fatalities (LCFs) are defined as death resulting from cancer that became active after a latent period following exposure to radiation.

D.2 RADIATION, CHEMICALS, AND OTHER INDUSTRIAL HAZARDS ARISING FROM NORMAL OPERATIONS

D.2.1 Radiation and Impacts to Human Health

Humans are constantly exposed to naturally occurring radiation through sources such as cosmic radiation and from the Earth’s rocks and soils. This type of radiation is referred to as *background radiation*, and it is always around us. Background radiation remains relatively constant over time and is present in the environment today, just as it was hundreds of years ago. In addition, humans are also exposed to man-made sources of radiation, including medical and dental x-rays, household smoke detectors, materials released from coal -burning power plants, and nuclear facilities. The following sections describe some important principles concerning the nature, types, sources, and effects of radiation and radioactivity.

D.2.1.1 What Is Radiation?

Some atoms have large amounts of energy and are inherently unstable. They may reach a stable, less energetic state through the emission of subatomic particles or electromagnetic radiation, a process referred to as radioactivity. *Ionizing radiation* has enough energy to free electrons from atoms, creating ions that can cause biological damage. Although it is potentially harmful to human health, ionizing radiation is used in a variety of ways, many of which are familiar to us in our everyday lives. An x-ray machine is one source of ionizing radiation. Likewise, most home smoke detectors use a small source of ionizing radiation to detect smoke particles in the room’s air. The two most common mechanisms by which man-made ionizing radiation is generated are the electrical acceleration of subatomic particles such as electrons (as in x-ray machines) and the emission of energy from nuclear reactions.

Some elements, such as uranium, radium, plutonium, and thorium, are unstable or radioactive by nature. As these elements change to more stable forms, they emit rays of energy or particles. This *radioactive decay*, or emission of energy or particles, is based on a specific decay rate termed the *half-life*. The half-life is the time it takes to lose half of the original radioactivity or

amount. That half-life may vary from a millionth of a second to billions of years depending on the element. Eventually, the radioactivity will essentially disappear.

As a radioactive element emits energy and particles, it changes into a different element that may or may not be radioactive. Eventually, however, a stable element results. This process may require several steps, or the stable element may result from the first decay. If several steps occur, the sequence of steps is known as a *decay chain*.

Non-ionizing radiation bounces off or passes through matter without displacing electrons. In this SWEIS, the term *radiation* describes ionizing radiation.

D.2.1.2 What Are Some Sources of Radiation?

Sources of radiation include naturally occurring background radiation and man-made radiation. Table D-1 shows the major sources and levels of background radiation dose to an average individual in the vicinity of SNL/NM and the collective dose to the population within 50 miles of the site. Examples of background radiation include cosmic radiation from space and radionuclides naturally in the environment, including radon. This background radiation dose is unrelated to SNL/NM operations. Examples of man-made radiation include medical x-rays, dental x-rays, and man-made products.

Cosmic radiation is ionizing radiation resulting from energetically charged particles from space (primarily the sun) that continuously hit the Earth's atmosphere. These particles and the secondary particles and photons they create are referred to as cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level. A person in Albuquerque, at an average altitude of about 5,000 feet above sea level, is exposed to more cosmic radiation than a person at sea level.

Terrestrial radiation is emitted from the radioactive materials in the Earth's rocks, soils, and minerals. Radon, radon progeny, potassium, thorium, and uranium are the elements responsible for most terrestrial radiation. This radiation dose varies geographically.

Internal radiation exposure occurs from the human body metabolizing radioactive material that has entered the body by inhalation, ingestion, or through an open wound. Natural radiation sources in the body include isotopes of uranium, thorium, radium, radon, bismuth, polonium, potassium, rubidium, and carbon. The major contributors to the annual dose for internal radioactivity are the short-lived decay products of radon, which contribute about 200 mrem per year.

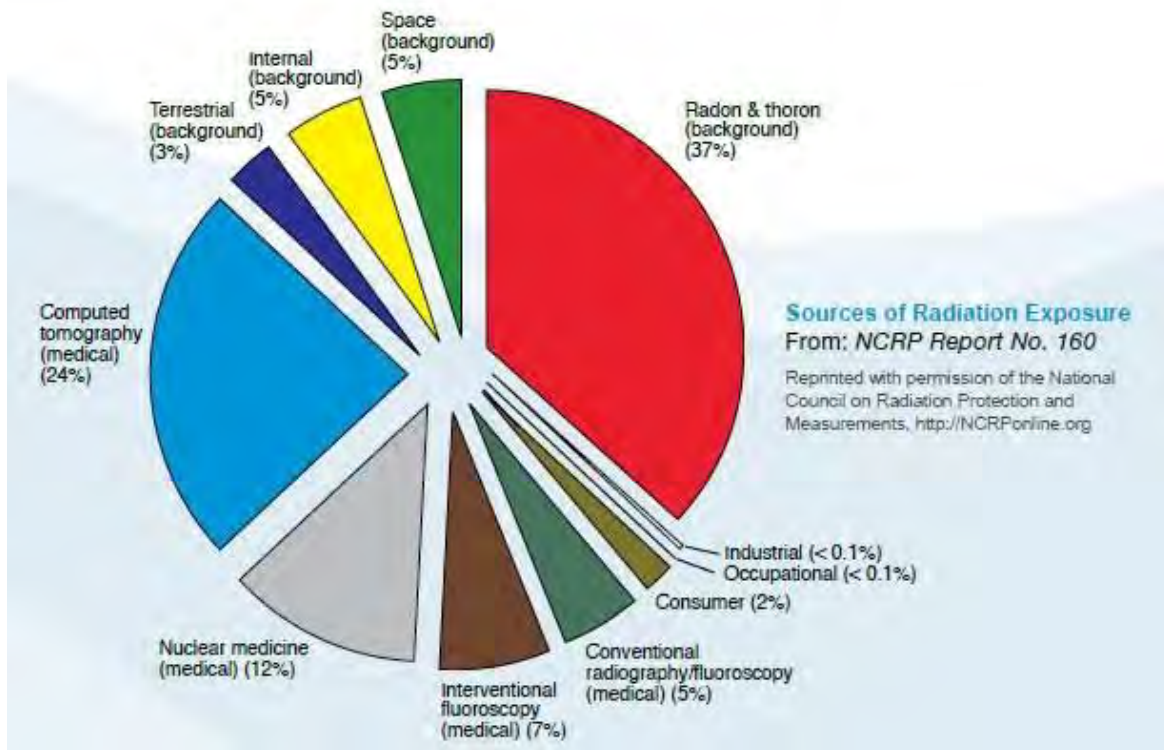
Consumer products also may contain sources of ionizing radiation. In some products, like smoke detectors and airport x-ray machines, the radiation source is essential to the operation of the product. In other products, such as televisions and tobacco products, the radiation occurs incidental to the product function.

Medical source radiation is an important diagnostic tool and is the main source of exposure to the public from man-made radiation. Exposure is deliberate, tightly controlled, and directly beneficial to the patient exposed. In general, medical exposures from diagnostic or therapeutic x-rays result from beams directed to specific areas of the body. Thus, all body organs generally

are not exposed uniformly. Nuclear medicine examinations and treatments may involve the internal administration of radioactive compounds by injection, inhalation, consumption, or insertion. Even then, radioactive elements are not usually distributed uniformly throughout the body. Radiation and radioactive materials also are used in the preparation of medical instruments, including the sterilization of heat-sensitive products such as plastic heart valves. Such use of radioactive materials normally does not expose the patient to any radiation dose but may expose personnel performing the preparation.

A few additional sources of radiation contribute minor dose to individuals in the United States. The radiation dose from nuclear fuel cycle facilities (e.g., uranium mines, mills, and fuel processing plants; nuclear power plants; transportation routes) has been determined to be less than 1 mrem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions of radioactive material from DOE facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials contribute less than 1 mrem per year to the average individual radiation dose. Air travel contributes about 1 mrem per year to the average dose.

Figure D-1 provides a visual of the sources of radiation to members of the public from background and man-made radiation and provides a relative percentage of the total that represents the contribution from each source. This is based on the national average annual background dose of 620 mrem.



Source: NCRP 2009.

Figure D-1. Sources of Radiation Exposure

Table D-1 provides the background radiation dose specific to Albuquerque, New Mexico. The average annual background dose in Albuquerque is 660 mrem. This is higher than the national

average due to increased cosmic and terrestrial background radiation geographically. The collective dose to the population assumes each of the individuals in the 50-mile population receives the same average background radiation, although some people will have higher or lower doses depending on their lifestyle, number of medical procedures, and degree of travel (to higher elevations or in airplanes). This collective background dose represents the expected baseline population exposure, unrelated to SNL/NM operations. It will be compared with the potential radiation exposures resulting from SNL/NM operations in Sections D.2.1.6 and D.2.1.7.

Table D-1. Background Radiation Dose Unrelated to SNL/NM Operations

Source	Individual Dose ^a [mrem (rem) per year]	Population	Collective Dose ^b (person-rem per year)
Natural Background Radiation at SNL/NM			
Cosmic and terrestrial radiation	89 (0.089)	1,073,460	95,538
Internal (food and water consumption)	29 (0.029)	1,073,460	31,130
Radon and thoron in homes (inhaled)	228 (0.228)	1,073,460	244,749
Common Man-Made Sources			
Diagnostic x-rays and nuclear medicine	300 (0.3)	1,073,460	322,038
Consumer products	13 (0.013)	1,073,460	13,955
Industrial plus occupational	1 (0.001)	1,073,460	1,073
Total	660 (0.66)	1,073,460	708,483

- a. The average background radiation dose to a person living in the vicinity of Albuquerque is about 660 mrem per year. In comparison, the average background radiation dose to the average U.S. resident is about 620 mrem per year. The higher background dose to a person living in the vicinity of Albuquerque is largely due to higher natural background radiation.
- b. Collective dose is the estimated dose to the entire population within a 50-mile radius of SNL/NM (about 1,073,460 people). Collective Dose = (Individual dose) × (population) × $\left(\frac{1 \text{ rem}}{1,000 \text{ mrem}}\right)$. The average dose to an individual in a year from naturally occurring background radiation (no man-made source) is $(89 + 29 + 228) \text{ mrem} = 346 \text{ mrem}$, which is just under 1 mrem per day on average.

Source: SNL 2022a and NRC 2023.

D.2.1.3 How Does Radiation Affect the Human Body?

Radiation affects the body through ionizations that can generate chemical changes in body material. These chemical changes can lead to alteration or disruption of the normal function of the affected area. At low levels of exposure, such as the levels experienced in an occupational or environmental setting, these chemical changes are small and innocuous. The body has a wide variety of mechanisms that repair any damage induced.

At much higher levels of whole-body exposure occurring over a short time period, damage is much more immediate, direct, and observable. Health effects can include reversible changes in the blood, other physiological responses, long-term health effects, and possibly death. Exposures to radiation at these levels are quite rare and are all associated with well-known international accidents. These levels of exposure have never occurred at SNL/NM.

Although unlikely due to the regulatory limits and low exposure levels, the most significant ill-health effect that may result from radiation exposures are cancer fatalities. These ill-health effects are referred to as “latent” cancer fatalities (LCFs) because the cancer takes many years to develop and be detected.

For low levels of radiation exposure, both national and international expert groups have extensively studied the probabilities for induction of various cancers or genetic effects. The problem is that the potential for health effects at low levels is extremely difficult to determine. The risk factors for radiation-induced cancer at low levels of exposure are small, and it is extremely important to account for the many non-radiation-related mechanisms for cancer induction, such as smoking, diet, lifestyle, chemical exposure, and genetic predisposition. These multiple factors also make it difficult to establish cause-and-effect relationships that could attribute high or low cancer rates to specific initiators, particularly since such initiators are still being discovered.

D.2.1.4 How Is Radiation Exposure Regulated?

Limits of exposure to members of the public and radiation workers are derived from International Commission on Radiological Protection (ICRP) recommendations. The U.S. Environmental Protection Agency (EPA) uses the National Council on Radiation Protection and Measurements and the ICRP recommendations and sets specific annual exposure limits in radiation protection guidance for federal agency documents. Each regulatory organization then establishes its own set of radiation standards.

Under conditions of the Atomic Energy Act of 1954, DOE is authorized to establish federal requirements controlling radiological activities at the DOE sites. The act also authorizes DOE to impose civil and criminal penalties for violations of these requirements. DOE regulates the release of radioactive materials and the potential level of radiation doses to workers and the public. Some DOE NNSA activities are also controlled through a DOE directives system that is contractually enforced.

DOE occupational radiation protection is regulated by Title 10 of the *Code of Federal Regulations* (CFR) Part 835. DOE has set occupational dose limits for an individual worker at 5,000 mrem per year. NNSA sites, such as SNL/NM, have set administrative control levels far below the dose limit to help enforce the goal of managing and controlling worker exposure to radiation and radioactive material ALARA. SNL/NM has established an administrative control level of 100 mrem per year for non-radiological workers and 250 mrem per year for radiological workers, with options to increase with managerial approval.

Environmental radiation protection is currently controlled contractually through DOE Order 458.1. This order applies to all DOE/NNSA contractor entities managing radioactive materials. This order sets annual dose standards to members of the public at 100 mrem through all exposure pathways. It requires that no member of the public receive an annual dose greater than 10 mrem from the airborne pathway and 4 mrem from ingestion of drinking water. National Emission Standards for Hazardous Air Pollutants (NESHAPs), found in 40 CFR 61 Subpart H, are the EPA regulations for compliance with airborne dose limits. NESHAPs limit dose from airborne releases of radionuclides to a maximum of 10 mrem per year to an individual member

of the public. Table D-2 shows the various dose limits set by DOE and EPA for radiation workers and members of the public.

Table D-2. Dose Limits for Members of the Public and Radiation Workers

Guidance Criteria (organization)	Member of the Public Dose Limits	Radiation Worker Dose Limit
10 CFR Part 835 (DOE)	100 mrem per year when entering a controlled area	5,000 mrem per year
DOE Order 458.1 (DOE)	10 mrem per year (all air pathways) ^a 4 mrem per year (drinking water pathways) ^b 100 mrem per year (all pathways)	--
40 CFR Part 61 (EPA)	10 mrem per year (all air pathways)	--
40 CFR Part 141 (EPA)	4 mrem per year (drinking water pathways)	--

a. Derived from 40 CFR Part 61.

b. Derived from 40 CFR Part 141.

D.2.1.5 Sources at SNL/NM That May Lead to Radiation Exposure

This section describes the primary types of radioactive sources at SNL/NM and how DOE/NNSA monitors, measures, and regulates radiation and radioactive materials. The environment potentially affected by radiological site releases includes water, air, and soil. These transport pathways (the environmental medium through which a contaminant moves) require an associated exposure pathway (e.g., inhaling air, drinking water, or dermal contact with soil) to affect human health.

Liquid discharges are one potential source of radiation release and exposure. Types of liquid discharge sources at SNL/NM include point- and area-source discharges and in-stream locations. A radiological monitoring plan is in place at SNL/NM, which is required to comply with DOE orders.

With regard to *soil emissions*, NNSA performs radiological analyses on soil and sediment samples annually. Statistical analyses of the 2023 results for the selected radionuclides revealed no statistically significant population differences nor any increasing trends in the onsite sample results. No further investigation is warranted; sampling will continue in the next calendar year (SNL 2023a).

Airborne emissions are the primary contributor to the potential for radiation dose at and around SNL/NM with operations involving radioactive materials.

In accordance with 40 CFR Part 61, Subpart H, SNL/NM performs air effluent monitoring of atmospheric discharge points to evaluate its compliance with local, state, and federal laws and regulations. Monitoring is performed to verify that protective measures have been successful. The results of monitoring air discharge points provide the actual emission source information for modeling, which is used to ensure that the NESHAP standard of 10 mrem per year total site effective-dose equivalent from the airborne pathway is not exceeded.

Many different radioactive elements are present at SNL/NM, including tritium, transuranic (TRU) isotopes, and others. Exhaust paths to the atmosphere include high-efficiency particulate

air (HEPA) filtered ventilation systems, roof vents and stacks without abatement devices, and potential releases to ambient air from diffuse sources.

Table D-3 lists the radionuclides and the total reported emissions from each of SNL/NM's radionuclide NESHAP sources in 2022.

Table D-3. Radionuclide Releases at SNL/NM by NESHAP Source, 2022

Source Name, Location	Description	Source Type	Monitoring Method	Radionuclide Emitted	Reported Release Activity (Curies [Ci] ^a / year)
Annular Core Research Reactor (ACRR), TA-V	Reactor used to subject various components or systems to pulse and steady-state neutron irradiation environments	Point	Periodic	Argon-41	1.79
Auxiliary Hot Cell Unit (AHCU), TA-V	Facility used to identify, sort, characterize, and repackage legacy nuclear materials for permanent removal; legacy material may include accountable nuclear material, spent nuclear fuel, and radiological material	Point	Periodic	Krypton-85 Strontium-90 Cesium-137 Tritium Samarium-151 Plutonium-241 Americium-241 Plutonium-238 Plutonium-239 Uranium-235m	2.00×10 ⁻⁸ 1.50×10 ⁻⁸ 1.00×10 ⁻⁸ 1.30×10 ⁻⁹ 2.80×10 ⁻¹⁰ 2.10×10 ⁻¹⁰ 7.00×10 ⁻¹¹ 2.80×10 ⁻¹¹ 2.60×10 ⁻¹¹ 2.60×10 ⁻¹¹
Explosives Components Facility, TA-II	Facility used to test neutron generator design and manufacturing	Point	Calculation	Tritium	3.00×10 ⁻³
High-Energy Radiation Megavolt Electron Source III (HERMES III), TA-IV	X-ray simulator used primarily to simulate the effects of prompt radiation from a nuclear burst on electronics	Point	Periodic	Nitrogen-13 Oxygen-15	7.33×10 ⁻⁴ 7.30×10 ⁻⁵
Ion Beam Laboratory, TA-I	Ion and electron accelerators used to study and modify materials systems	Point	Calculation	Tritium	13.3
Neutron Generator Facility, TA-I	Principal production facility used for neutron generators	Point	Continuous	Tritium	15.77

Source Name, Location	Description	Source Type	Monitoring Method	Radionuclide Emitted	Reported Release Activity (Curies [Ci] ^a / year)
Radioactive and Mixed Waste Management Unit (RMWMU), TA-III	Facility used to handle radioactive and mixed waste	Point	Continuous and calculation	Tritium (oxide) Tritium (elemental) Plutonium-238 Plutonium-239 Plutonium-240 Plutonium-241 Plutonium-242 Americium-241 Uranium-234 Uranium-235 Uranium-238 Strontium-90 Cesium-137 Tritium (particulate)	7.34×10^{-6} 4.57×10^{-6} 6.91×10^{-10} 2.03×10^{-6} 7.50×10^{-9} 1.66×10^{-8} 4.34×10^{-13} 3.1×10^{-9} 3.70×10^{-7} 4.60×10^{-8} 1.18×10^{-6} 5.02×10^{-6} 5.02×10^{-6} 1.10×10^{-3}
Z-Machine Facility, TA-IV	Experimental facility used to research light-ion inertial confinement fusion	Point	Calculation	Tritium	1.15

- a. Curies are the unit used to define the amount of radioactive material. Scientific notation is used to present very small numbers of curies. For instance, 2.00×10^{-8} is equivalent to 0.00000002 Ci per year.

Source: SNL 2022a, SNL 2025.

Reported release activity values are used to calculate the dose for comparison with the limits for members of the public provided in DOE Order 458.1 and in NESHAP regulations (40 CFR Part 61).

D.2.1.6 Methodology for Estimating Radiological Impacts for Normal Operations

Radioactivity released to the atmosphere and corresponding doses from normal operations at NNSA sites are presented in the applicable Annual Site Environmental Report (ASER). Radiation doses are calculated for the maximally exposed individual (MEI) and the entire population residing within 50 miles of the center of the site. In this SWEIS, dose calculations from normal operations were made based on the Clean Air Act Assessment Package – Personal Computer (CAP88-PC) package of computer codes.¹

¹ Version 4.1.1 (EPA 2023), developed under EPA sponsorship to demonstrate compliance with 40 CFR Part 61, Subpart H, which governs the emissions of radioactive elements other than radon from DOE facilities.

D.2.1.7 Baseline Risk Estimates and Health Effects for Potential Radiation Exposures to the Public

This SWEIS presents risk estimates using LCFs. The probability of an individual worker or member of the public contracting a LCF is 0.0006 per rem. Similarly, the probability of an LCF within an exposed population is 0.0006 per person-rem.² This SWEIS presents only estimates of potential excess fatal cancers beyond what is considered naturally occurring. The radiation exposure risk estimators are denoted as excess because they result in fatal cancers above the naturally occurring annual rate of 146 per 100,000 population nationally.³

Dose to the MEI. The MEI is a hypothetical member of the public who – because of realistically assumed proximity, activities, and living habits – would receive the highest radiation dose, taking into account all pathways, from a given event, process, or facility. For SNL/NM, NNSA also calculates the radiation dose to the onsite MEI. For SNL/NM to comply with the NESHAP regulations, the MEI cannot receive an effective dose equivalent greater than 10 mrem per year per site for the air pathway.

As required by DOE Order 458.1, NNSA calculates doses to the following members of the public:

- the total human population within 50 miles of the site, and
- the hypothetical MEI.

To identify the location of and the total dose to the hypothetical MEI, the following are considered:

- the air-pathway dose,
- other locations with measurable doses, and
- the offsite dose.

Collective Dose to the Population within 50 Miles. The collective population radiation dose from SNL/NM operations is the sum of the doses for each member of the public within a 50-mile radius of SNL/NM. Outside of Bernalillo County, the radiation doses due to SNL/NM operations are too small to measure directly, so the collective radiation dose is calculated by modeling the transport of radioactive air emissions using CAP88.

Table D-4 presents the annual radiation doses to the public from SNL/NM emissions of radioactive materials to the air from 2018 to 2022. Doses are presented for an MEI and the population within a 50-mile radius of SNL/NM. These doses fall within radiological exposure

² The Interagency Steering Committee on Radiation Standards (Lawrence 2002) recommended a risk estimator of 0.0006 excess (above those naturally occurring) fatal cancers per person-rem of dose in order to assess health effects to the public and to workers.

³ In 2019, the latest year for which incidence data are available nationally, for every 100,000 people, 146 died of cancer (USCSWG 2022).

limits presented in Table D-2 and are much lower than the background radiation dose presented in Table D-1 (dose to the MEI is less than 0.07 percent of the 10 mrem limit and 0.001 percent above the normal background dose).

Table D-4. Annual Radiation Doses to the Public from SNL/NM Operations (2018–2022)

Year	Annual Dose to Offsite MEI (mrem)	Annual Dose to an Individual with 50 miles (mrem)	Population	Collective Dose (person-rem) ^a
2018	1.7×10^{-2b}	1.7×10^{-5}	1,073,460	1.8×10^{-2}
2019	6.5×10^{-4}	2.3×10^{-5}	1,073,460	2.4×10^{-2}
2020	2.7×10^{-4}	1.0×10^{-5}	1,073,460	1.1×10^{-2}
2021	8.5×10^{-3}	3.1×10^{-5}	1,073,460	3.3×10^{-2}
2022	6.5×10^{-3}	2.5×10^{-5}	1,073,460	2.7×10^{-2}
2018 to 2022 average	6.6×10^{-3} (0.0066 mrem)	2.1×10^{-5} (0.000021 mrem)	1,073,460	2.3×10^{-2} (0.023 person-rem)

- Collective dose is the estimated dose to the entire population within a 50-mile radius of SNL/NM (about 1,073,460 people). Collective Dose = (Individual dose) $\times$ (population) $\times$ $\left(\frac{1 \text{ rem}}{1,000 \text{ mrem}}\right)$.
- a. Scientific notation is used to simplify the presentation; as a clarifying example, 1.7×10^{-2} mrem is the same as 0.017 mrem.

Source: SNL 2019a; SNL 2020a; SNL 2021a; SNL 2022a; and SNL 2023a.

Based on the information in Table D-4, the offsite MEI would have an average dose of 0.0066 mrem in each year. This is insignificant compared to the average naturally occurring background (no man-made sources) of 346 mrem in year (about 1 mrem in a day).

Based on the information in Table D-4, the risk to the general population is insignificant compared with other common daily risks. With an average yearly collective dose of 0.023 person-rem, the expected number of deaths from SNL/NM doses is:

$$\text{Estimated Number of Deaths} = (\text{Collective Dose}) \times (\text{LCF Risk Factor})$$

$$\text{Estimated Number of Deaths} = \left(0.023 \frac{\text{person-rem}}{\text{year}}\right) \times \left(0.0006 \frac{\text{deaths}}{\text{person-rem}}\right) = 0.000138 \text{ deaths per year}$$

For perspective, this number may be compared with the about 1,567 fatal cancers expected within the 50-mile radius population from all causes unrelated to SNL/NM operations.^{4,5}

⁴ The latest mortality rate associated with cancer for the entire U.S. population in 2019 (for which final data are available) was 146 per 100,000 people (USCSWG 2022). Based on this national cancer mortality rate, about 1,567 fatal cancers would be expected to occur annually in the population of about 1,073,460 people living within 50 miles of SNL/NM.

⁵ In 2019, the latest year for which incidence data are available, for every 100,000 people, 146 died of cancer (USCSWG 2022).

D.2.1.8 Risk Estimates and Health Effects for Potential Radiation Exposures to the Public for the SWEIS Alternatives

No-Action Alternative. Under normal operations, public radiation doses may occur from airborne releases during continued operations. Compared to the existing baseline, projects under the No-Action Alternative would not change the radioactive air emissions during normal operations. NNSA has estimated that a maximum of 47 Ci could be released to the air under the No-Action Alternative during normal operations. The offsite MEI, collective dose, and potential LCF are presented in Table D-5.

Table D-5. Annual Radiological Impacts to the Public from Potential SNL/NM Operational Radiological Emissions under the SWEIS Alternatives

Receptor/Dose/Risk	Baseline (Existing Environment)	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Offsite MEI ^a				
Dose (mrem)	0.0066	0.0066	0.0166	0.025
Population within 50 Miles ^b				
Collective dose (person-rem)	0.023	0.023	0.033	0.05
LCF Risk Factor ^c	0.0006	0.0006	0.0006	0.0006
LCF ^b	0.000014	0.000014	0.00002	0.00003

a. The offsite MEI at SNL/NM is assumed to be located at the Kirtland Air Force Base (KAFB) Eubank Gate area.

b. Based on projection of about 1,073,460 people living within 50 miles of SNL/NM in the year 2020.

c. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem.

Source: NTESS 2023a.

Modernized Operations Alternative. Under normal operations, public radiation doses may occur from airborne releases from continued operations and implementation of the Modernized Operations Alternative. Most of the new facilities would be replacements for existing facilities that have reached their end of life, and there would be no changes in radioactive air emissions. NNSA has estimated that there would be a maximum of 52 Ci released to the air under the Modernized Operations Alternative, which is conservatively based on the highest amount of radioactivity released in one year over the period 2018–2022. The offsite MEI, collective dose, and LCF are presented in Table D-5.

Expanded Operations Alternative. Under normal operations, public radiation doses may occur from airborne releases from continued operations. In addition, under the Expanded Operations Alternative, the Combined Radiation Environments for Survivability Testing (CREST) Complex would replace the Annular Core Research Reactor (ACRR) facility, and the Next Generation Pulsed-Power (NGPP) Facility would replace the Z-machine. For the Expanded Operations Alternative, this SWEIS conservatively assumes a 50 percent increase in operations at facilities that emit radioactive material, and radioactive air emissions are estimated at 78 Ci per year for all facilities, plus an additional 11.8 Ci from the CREST Complex (NTESS 2023a). The offsite MEI, collective dose, and LCF are presented in Table D-5.

Table D-5 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs from SNL/NM operations for the alternatives analyzed in this SWEIS. The Expanded Operations Alternative would yield the highest potential dose to the public and can be evaluated as follows:

- The MEI (0.025 mrem) is significantly less than the most restrictive limit of 4 mrem. Conversion of the expected collective population dose to health risk predicts 0.00003 cancer deaths from SNL/NM doses. The risk to the general population is insignificant compared with other common daily risks. For perspective, this number may be compared with the approximately 1,567 fatal cancers expected in the same population from all causes unrelated to SNL/NM operations.^{6,7}

D.2.1.9 Baseline Risk Estimates and Health Effects for Potential Radiation Exposures to Workers

SNL/NM workers receive the same dose as the general public from background radiation, but also may receive an additional dose from working in facilities with radiological materials and radiation -generating devices such as accelerators. Table D-6 presents the annual average individual and collective worker doses from SNL/NM operations from 2017 to 2021. These doses fall within the regulatory limits presented in Table D-2.

Table D-6. Radiation Doses to SNL/NM Workers from Operations (2017–2021)

Occupational Personnel	2017	2018	2019	2020	2021	Average
Number of workers receiving a measurable dose	73	175	154	89	105	119
Total (collective) worker dose (person-rem)	2.15	5.82	5.32	3.29	3.09	3.93
Average worker dose (mrem) ^a	29.5	33.3	34.6	36.9	29.4	32.7

- a. The radiological dose limit for an individual worker is 5,000 mrem per year (10 CFR Part 835). SNL/NM has established an administrative control level of 250 mrem per year for radiological workers, with options to increase with managerial approval.

Source: DOE 2021a and DOE 2023a.

In 2017–2021, no worker exceeded DOE’s 5-rem-per-year dose limit (DOE 2021a and DOE 2023a), and administrative control levels were maintained ALARA.

⁶ The latest mortality rate associated with cancer for the entire U.S. population in 2019 (for which final data are available) was 146 per 100,000 people (USCSWG 2022). Based on this national cancer mortality rate, about 1,567 fatal cancers would be expected to occur annually in the population of about 1,073,460 people living within 50 miles of SNL/NM.

⁷ In 2019, the latest year for which incidence data are available, for every 100,000 people, 146 died of cancer (USCSWG 2022).

D.2.1.10 Risk Estimates and Health Effects for Potential Radiation Exposures to Workers for the SWEIS Alternatives

No-Action Alternative. Table D-7 presents the estimates of annual radiological doses to workers for the No-Action Alternative. The annual doses to individual workers would be well below the DOE limit of 5,000 mrem (10 CFR Part 835) and the SNL/NM administrative control level of 250 mrem per year for radiological workers, with options to increase the administrative control level with managerial approval. Under the No-Action Alternative, the total annual collective dose to all radiological SNL/NM workers would be 2.38 person-rem, which would result in 0.0014 LCFs annually.

Table D-7. Annual Radiological Impacts to SNL/NM Workers from Operations under the SWEIS Alternatives

Receptor/Dose/Risk	Baseline ^a (Existing Environment)	No-Action Alternative ^a	Modernized Operations Alternative	Expanded Operations Alternative
Number of workers who receive a measurable dose	120	175	200	262
Average annual radiological dose to worker (mrem)	33	45.8	47.5	80.5
Average annual radiological risk to workers (LCFs) ^b	2.0×10^{-5c}	2.7×10^{-5}	2.8×10^{-5}	4.8×10^{-5}
Collective annual radiological dose to workers (person-rem)	2.38	8.02	9.5	21.1
Total annual radiological risk to workers (LCFs) ^b	0.0014	0.0048	0.0057	0.13

a. The baseline values are based on the average number of workers and doses during 2018–2022. The No-Action Alternative values are based on the highest number of workers during 2018–2022 and highest estimated doses for the future.

b. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem.

c. Scientific notation is used to present very small numbers. For instance, 2.00×10^{-5} is equivalent to 0.00002.

Source: NTESS 2023a.

A total of 10 buildings and support facilities, with a footprint of 117,142 square feet (2.7 acres), would undergo decontamination, decommissioning, and demolition (DD&D) under the No-Action Alternative. In terms of square footage, most (87 percent) of this DD&D would occur in Technical Area (TA) I, with the remainder in TA-III and the Coyote Test Field. None of the facilities houses radiological operations or has radiological contamination, so no radiological doses would result from this DD&D.

Modernized Operations Alternative. NNSA has estimated that the number of workers who receive a measurable radiation dose would increase from 120 (No-Action Alternative) to 200 under the Modernized Operations Alternative. The average worker dose associated with the Modernized Operations Alternative is conservatively assumed to be the highest annual dose that occurred over the period 2018–2022, with the exception of ACRR radiation workers. The ACRR is expected to increase the number of operations from 250 experiments per year to 310, and ACRR fuel recladding could also increase worker dose. In total, the annual dose to ACRR radiation workers could increase to 100 mrem (SNL 2023b), still well within limits.

More than 40 buildings and other support facilities with a total footprint of 656,000 square feet (15 acres) would be scheduled to undergo DD&D under the Modernized Operations Alternative. None of the facilities houses radiological operations or has radiological contamination, so no radiological impacts to workers would result from this DD&D.

Table D-7 presents the estimates of annual radiological doses to workers for the Modernized Operations Alternative. Under the Modernized Operations Alternative, the total annual collective dose to all SNL/NM radiological workers would be 9.5 person-rem, which would result in 0.0057 LCFs annually to the SNL/NM workforce.⁸

Expanded Operations Alternative. NNSA has estimated that the number of workers who receive a measurable radiation dose would increase from 120 (No-Action Alternative) to 262 under the Expanded Operations Alternative. Of these 262 workers, 25 would be ACRR workers (until the facility is eventually phased out), and 37 would be CREST Complex workers. The dose to non-ACRR and non-CREST Complex workers is conservatively assumed to increase from 40 mrem to 60 mrem annually as a result of potential increased operations. ACRR workers are estimated to receive an average dose of 100 mrem per year, and CREST Complex workers are estimated to receive an average dose of 178 mrem per year. Operation of a microreactor would require about 10 workers involved in radiological operations, each of whom could receive radiation exposure of about 2 mrem per year (NTESS 2023a).

Approximately 50 facilities and other support facilities with a total footprint of 448,000 square feet would be scheduled to undergo DD&D under the Expanded Operations Alternative. Two facilities contain radiological exclusion areas and could have minor radiological contamination. However, any increased dose to workers is expected to fall within the 60 mrem dose identified in this section.

Table D-7 presents the estimates of annual radiological doses to workers for the Expanded Operations Alternative. Under the Expanded Operations Alternative, the total annual collective dose to all SNL/NM workers would be 21.1 person-rem, which would result in 0.13 LCFs annually to the SNL/NM workforce.⁹

D.2.2 Hazardous Chemicals, Other Industrial Hazards, and Impacts to Human Health

D.2.2.1 Non-Radiological

SNL/NM is a research site using a large variety of hazardous materials. SNL/NM operations represent a potential for exposure of some workers to hazardous materials (such as solvents, metals, and carcinogens). Typically, operations are controlled through specific work control

⁸ Of the 200 workers, 175 workers would receive an average dose of 40 mrem per year, and 25 ACRR workers would receive an average dose of 100 mrem per year.

⁹ Of the 262 workers, 200 workers would receive an average dose of 60 mrem per year, 25 ACRR workers would receive an average dose of 100 mrem per year, and 37 CREST Complex workers would receive an average dose of 178 mrem per year.

documents so that those workers may be exposed to low levels of a wide variety of chemicals that are below a threshold of concern throughout the duration of their research.

Workers receive information and training on identified hazards and follow the requirements in specific work control documents to protect them and minimize hazards and exposures. SNL/NM has several programs and procedures in place to direct the monitoring, handling, storage, and use of hazardous materials. Work activities are periodically monitored with measurements taken at personal breathing zones and general work areas. ES&H monitoring records indicate that personnel exposure to hazardous materials is maintained well below established regulatory requirements and exposure guidelines.

Carcinogens. Carcinogens are used in SNL/NM operations only when it is not possible to use a non-carcinogenic material. Any use of carcinogens requires stringent controls to be in place to prevent exposures to workers, the public, and the environment. Examples of operations where carcinogenic materials may be encountered include:

- work that generates or involves contact with soot and tar;
- use of mineral oil products that may contain polyaromatic hydrocarbons;
- electric arc discharge machining;
- discharging of gas propellants in a vacuum;
- generating hardwood dust, including carpentry and cabinet-making activities;
- spraying hexavalent chromium compounds, including, but not limited to, primers, paints, and sealants containing barium, calcium, sodium, strontium, or zinc chromate;
- handling inorganic arsenic compounds and arsenic metal, including gallium arsenide, in a manner that can result in exposure to arsenic; and
- using asbestos, laser dyes, or lead and lead compounds.

At SNL/NM, employees use chemical carcinogens only when required by a specific research project. Industrial hygiene staff monitor worker exposures to certain hazardous materials and track exposures using an occupational exposure database. Likewise, personnel may be monitored for certain chemical agents by way of routine medical examinations performed by the SNL/NM Health Services Department. All employees who work with carcinogens must receive sufficient information and training so that they may work safely and understand the significance of the potential hazard they may encounter.

D.2.2.2 How Does DOE/NNSA Regulate Chemical Exposures?

Environmental Protection Standards. DOE Order 450.1 requires implementation of sound stewardship practices that protect the air, water, land, and other natural and cultural resources impacted by DOE operations and by which DOE cost-effectively meets or exceeds compliance with applicable environmental, public health, and resource protection laws, regulations, executive orders, and DOE requirements. Applicable federal and state environmental acts/agreements include:

- Resource Conservation and Recovery Act (RCRA)
- Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act
- Federal Facility Compliance Agreement
- Endangered Species Act
- Safe Drinking Water Act
- Clean Water Act (which resulted in the establishment of the National Pollutant Discharge Elimination System [NPDES] and pretreatment regulations for publicly owned treatment works)
- Clean Air Act (Title III, Hazardous Air Pollutants Rad-NESHAP, Asbestos NESHAP)
- Toxic Substances Control Act
- Federal Insecticide, Fungicide, and Rodenticide Act

Many of these acts/agreements include environmental standards that must be met to ensure the protection of the public and the environment. Most of the acts/agreements require completed permit applications in order to treat, store, dispose of, or release contaminants to the environment. The applicable environmental standards and reporting requirements are set forth in the issued permits and must be met to ensure compliance.

The Emergency Planning and Community Right-to-Know Act, also referred to as Title III, requires reporting of emergency planning information, hazardous chemical inventories, and environmental releases to federal, state, and local authorities. The annual Toxics Release Inventory report addresses releases of toxic chemicals into the environment, waste management activities, and pollution prevention activities associated with those chemicals.

Regulated Occupational Exposure Limits. The Occupational Safety and Health Administration (OSHA) regulates occupational limits for hazardous chemicals. The permissible exposure limits represent the legal concentration levels set by OSHA that are safe for 8-hour exposures without causing non-cancer health effects. Other agencies, including the National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH), provide guidelines. The NIOSH guidelines are recommended exposure limits, and the ACGIH guidelines are threshold limit values. Occupational limits are further defined as time-weighted averages (TWAs), or concentrations for a conventional 8-hour workday and a 40-hour workweek, to which it is believed nearly all workers may be exposed, day after day, without adverse effects. Often, ceiling limits, or airborne concentrations that should not be exceeded during any part of the workday, are also specified. In addition to the TWA and ceiling limit, short-term exposure limits may be set. Short-term exposure limits are 15-minute TWA exposures that should not be exceeded at any time during a workday, even if the 8-hour TWA is within limits. OSHA also uses action levels to trigger certain provisions of a standard (e.g., appropriate workplace precautions, training, and medical surveillance) for workers whose exposures could approach the permissible exposure level.

D.2.2.3 Other Industrial Hazards

During normal operations, SNL/NM workers may be exposed to hazardous conditions that can cause injury or death. The potential for health impacts varies among facilities and workers. Workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, materials substitution, and engineering and management controls. Under 10 CFR Part 851, DOE lists the requirements for a worker safety and health program to ensure that DOE contractors and their workers operate a safe workplace. DOE establishes procedures for investigating whether a violation of a requirement of this part has occurred, for determining the nature and extent of any such violation, and for imposing an appropriate remedy. In addition, 10 CFR Part 851 incorporates many OSHA requirements and other protections. Appropriate monitoring that reflects the frequency and quantity of chemicals used in the operational processes ensures that these standards are not exceeded. DOE also requires that conditions in the workplace minimize hazards that cause, or are likely to cause, illness or physical harm.

SNL/NM's occupational health and safety performance is measured by injury and illness rates (total recordable case [TRC] and days away, restricted, or transferred [DART]) pursuant to DOE orders that use OSHA criteria. As shown in Table D-8, the TRC rate at SNL/NM has varied between 0.72 and 1.46 over the past 5 years, with an average TRC rate of 1.1; this means that for every 100 workers at SNL/NM, there is about 1.1 work-related injury or illness annually that results in either death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness. DART represents severe injuries annually. As shown in Table D-8, the DART rate at SNL/NM has varied between 0.31 and 0.9 over the past 5 years, with an average DART rate of 0.5; this means that for every 100 workers at SNL/NM, there is an average of about 0.5 work-related severe injuries or illnesses annually that result in days away from work or days of job restriction or transfer.

Table D-8. Occupational Injury Statistics for SNL/NM (2018–2022)

Rate	2018	2019	2020	2021	2022	Average
TRC Rate ^a	1.09	1.09	0.72	1.21	1.46	1.1
DART Rate ^b	0.50	0.34	0.31	0.55	0.90	0.5

a. TRC Rate: Work-related injuries or illnesses that resulted in either death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness per 100 workers.

b. DART Rate: Injuries or illnesses in which the most serious outcome of the case resulted in days away from work or days of job restriction or transfer per 100 workers.

Source: DOE 2023b.

During normal operations, SNL/NM workers may be exposed to hazardous conditions that can cause injury or death. The potential for health impacts varies among facilities and workers. In 2021, work-related injuries included slips, trips, and falls resulting in fractures, sprains, and strains; struck-against/by injuries resulting in lacerations and abrasions; and lift/push/pull injuries resulting primarily in strains. There were 242 TRC cases and 147 DART cases at SNL/NM in 2022 (DOE 2023b). No work-related fatalities occurred at SNL/NM during the period 2018–2022.

D.2.2.4 Impacts for the Alternatives

No-Action Alternative. Potential human health impacts to workers were evaluated using Bureau of Labor Statistics (BLS) occupational injury/illness/fatality rates. Injury/illness/fatality rates at DOE/NNSA sites are historically lower than BLS values due to the increased focus on safety fostered by ongoing health and safety processes. Table D-9 lists the potential estimates of injuries/illnesses and fatalities estimated in an average year for the No-Action Alternative. As shown in the table, in an average year, about 384.5 days of lost work from illness/injury and 1.08 fatalities would be expected from SNL/NM operations under the No-Action Alternative. For illness/injury, this would represent an increase of 1.1 percent compared to the existing baseline. For fatalities, the increase would be 3.8 percent above the existing baseline. These are statistical estimates and are expected to be conservative based on BLS data. NNSA notes that no work-related fatalities occurred at SNL/NM during the period 2018–2022.

Table D-9. Occupational Injury/Illness and Fatality Estimates at SNL/NM for Construction, DD&D, and Operations under the No-Action Alternative

Injury, Illness, and Fatality Categories	Baseline (Existing Environment)			No-Action Alternative			Percent Change versus Baseline ^d
	Construction and DD&D ^a	Operations ^a	Total	Construction and DD&D ^b	Operations ^c	Total	
Lost days due to injury/illness ^e	27.3	353	380.3	31.5	353	384.5	+1.1%
Number of fatalities ^f	0.24	0.8	1.04	0.28	0.8	1.08	+3.8%

- Existing workforce of 14,378 workers is estimated to have 13,078 operational workers and 1,300 additional contractor workers who perform construction and DD&D.
- Based on 1,500 contractor workers who perform construction and DD&D.
- Based on 13,078 operational workers.
- Percent change is presented for the “Total.”
- Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 2.7 injuries in New Mexico per 100 workers for manufacturing (operations).
- Based on 18.4 fatalities in New Mexico per 100,000 workers for construction/DD&D and 6.2 fatalities in New Mexico per 100,000 workers for all occupations (operations). (Note: Data for manufacturing-related fatalities are not available for New Mexico.)

Source: BLS 2021.

Non-Ionizing Radiation. Technologies used at SNL/NM that generate non-ionizing radiation¹⁰ include lasers, microwave-generating and radiofrequency devices, technologies that generate ultraviolet radiation, video displays and instrumentation, welding, and security-related devices. Devices that generate non-ionizing radiation are regulated by the U.S. Food and Drug Administration, while worker exposures are regulated by OSHA. Public exposures are not

¹⁰ Non-ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy to ionize living material, that is, to completely remove an electron from an atom. Because non-ionizing radiation has lower energy than ionizing radiation, it has fewer health risks than ionizing radiation.

expected as any non-ionizing radiation generated by site operations are localized in nature. Devices that can generate larger amounts of non-ionizing radiation, such as some lasers, can cause eye injury to anyone who looks directly into the beam, or can cause skin burns. Worker exposures could occur because of equipment failure, improper use of equipment, or non-adherence to procedures.

Non-Radiological Air Emissions and Chemicals. With regard to health impacts associated with non-radiological air emissions, the Laboratories' emissions of regulated pollutants are below the limits in SNL/NM's Title V Operating Permit. As shown in Table D-10, emissions of hazardous air pollutants and volatile organic compounds were significantly below the Title V Operating Permit limits (SNL 2022a).

Table D-10. Emissions of Volatile Organic Compounds and Hazardous Air Pollutants from Chemical Use in Research and Development Activities at SNL/NM

Pollutant	Requested Title V Operating Permit Limits Emissions (tons/year)	2021 Emissions (tons/year)
Hazardous Air Pollutants	<25	10.68
Volatile Organic Compounds	32	2.48

Source: SNL 2022a.

There are no measurable non-radiological health effects to the public from SNL/NM air emissions (SNL 2022a). With regard to health impacts associated with non-radiological effluents, based on annual analyses, NNSA has concluded that there is no measurable risk to the public from exposure to surface water and sediment resulting from either current or legacy SNL/NM releases (SNL 2022a).

Workers would be protected from overexposure to hazardous chemicals by adherence to regulatory occupational standards that limit concentrations of potentially hazardous chemicals. DD&D activities have the potential to cause exposure to chemical hazards. With regard to the facilities scheduled to undergo DD&D under the No-Action Alternative, incidental hazardous material (such as asbestos and lead-based paint contamination) could be present but is expected to be less than 5 percent of the total facility square footage. Prior to DD&D, facilities would be characterized to identify waste types (e.g., hazardous waste), construction material types (e.g., steel, roofing, concrete), presence of equipment, levels of contamination, expected waste volumes, and other information to support safe demolition. Pre-demolition surveys would identify any asbestos-containing material present, and the material would be handled and disposed of according to applicable regulations. Any hazardous material would be disposed of at a licensed offsite treatment, storage, and disposal facility.

Overall site usage of chemicals would increase under the No-Action Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. As discussed in Chapter 5, Section 5.2, the square footage associated with new facilities with expanded or new laboratory or research functions could increase for the No-Action Alternative compared to existing operations at SNL/NM. However, no notable chemical-related health impacts are associated with normal operations at SNL/NM (SNL 2022a). Initial hazard screenings did not identify any additional controls necessary to protect the public from direct

chemical exposures during normal operations. Section D.3 presents potential impacts from chemical accidents.

Modernized Operations Alternative. Table D-11 lists the potential estimates of injuries/illnesses and fatalities estimated in an average year for the Modernized Operations Alternative. As shown in the table, in an average year, about 440 days of lost work from illness/injury and 1.2 fatalities would be expected from SNL/NM operations under the Modernized Operations Alternative. For illness/injury, this would represent an increase of 14.4 percent compared to the No-Action Alternative. For fatalities, the increase would be 11.1 percent above the No-Action Alternative. These are statistical estimates and are expected to be conservative based on BLS data. NNSA notes that no work-related fatalities occurred at SNL/NM during the period 2018–2022.

Table D-11. Occupational Injury/Illness and Fatality Estimates at SNL/NM for Construction, DD&D, and Operations under the Modernized Operations Alternative

Injury, Illness, and Fatality Categories	No-Action Alternative			Modernized Operations Alternative			Percent Increase over No-Action Alternative ^d
	Construction and DD&D ^a	Operations ^a	Total	Construction and DD&D ^b	Operations ^c	Total	
Lost days due to injury/illness ^e	31.5	353	384.5	36	404	440	14.4%
Number of fatalities ^f	0.28	0.8	1.08	0.32	0.92	1.2	11.1%

- No-Action Alternative workforce of 14,578 workers is estimated to have 13,078 operational workers and 1,500 additional contractor workers who perform construction and DD&D.
- Based on 1,700 contractor workers who perform construction and DD&D.
- Based on 14,960 operational workers.
- Percent change is presented for the “Total.”
- Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 2.7 injuries in New Mexico per 100 workers for manufacturing (operations).
- Based on 18.4 fatalities in New Mexico per 100,000 workers for construction/DD&D and 6.2 fatalities in New Mexico per 100,000 workers for all occupations (operations). (Note: Data for manufacturing-related fatalities are not available for New Mexico.)

Source: BLS 2021.

Non-Radiological Air Emissions and Chemicals. None of the actions proposed under the Modernized Operations Alternative would result in emissions of regulated pollutants above amounts requested in SNL/NM’s Title V Operating Permit and/or non-radiological effluents. Consequently, NNSA has concluded that there is no measurable risk to the public from exposure to non-radiological air emissions or non-radiological effluents. Overall site usage of chemicals would increase under the Modernized Operations Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. However, no notable chemical-related health impacts are associated with normal (accident-free) operations at SNL/NM. Section D.3 presents the potential impacts of chemical accidents.

Non-Ionizing Radiation Hazards. Potential human health impacts associated with working with non-ionizing radiation would be the same as presented for the No-Action Alternative.

Expanded Operations Alternative. Table D-12 lists the potential estimates of injuries/illnesses and fatalities estimated in an average year for the Expanded Operations Alternative. As shown in the table, in an average year, about 524 days of lost work from illness/injury and 1.5 fatalities would be expected from SNL/NM operations under the Expanded Operations Alternative. For illness/injury, this would represent an increase of 36 percent compared to the No-Action Alternative. For fatalities, there would be a 35 percent increase compared to the No-Action Alternative. These are statistical estimates and are expected to be conservative based on BLS data. NNSA notes that no work-related fatalities occurred at SNL/NM during the period 2018–2022.

Table D-12. Occupational Injury/Illness and Fatality Estimates at SNL/NM for Construction and Operations under the Expanded Operations Alternative

Injury, Illness, and Fatality Categories	No-Action Alternative			Expanded Operations Alternative			Percent Change versus No-Action Alternative ^d
	Construction and DD&D ^a	Operations ^a	Total	Construction ^b	Operations ^c	Total	
Lost days due to injury/illness ^e	31.5	353	384.5	40	484	524	36%
Number of fatalities ^f	0.28	0.8	1.08	0.36	1.1	1.5	35%

- No-Action Alternative workforce of 14,578 workers is estimated to have 13,078 operational workers and 1,500 additional contractor workers who perform construction and DD&D.
- Based on 1,900 contractor workers who perform construction and DD&D.
- Based on 17,950 operational workers.
- Percent change is presented for the “Total.”
- Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 2.7 injuries in New Mexico per 100 workers for manufacturing (operations).
- Based on 18.4 fatalities in New Mexico per 100,000 workers for construction/DD&D and 6.2 fatalities in New Mexico per 100,000 workers for all occupations (operations). (Note: Data for manufacturing-related fatalities are not available for New Mexico.)

Source: BLS 2021.

None of the actions proposed under the Expanded Operations Alternative would result in emissions of regulated pollutants above amounts requested in SNL/NM’s Title V Operating Permit and/or non-radiological effluents. Consequently, NNSA has concluded that there is no measurable risk to the public from exposure to non-radiological air emissions and/or effluents. Overall site usage of chemicals would increase under the Expanded Operations Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. However, no notable chemical-related health impacts are associated with normal (accident-free) operations at SNL/NM. Section D.3 presents the potential impacts of chemical accidents.

D.3 ACCIDENT ANALYSIS

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. The buildings and facilities at SNL/NM contain radiological, chemical, biological, and energetic (explosive) materials. An accident can involve a combined release of energy and hazardous materials (radiological, chemical, or biological) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent on or independent of the initial event, which dictate the accident's progression and the extent of materials released.

If an accident were to occur involving the release of radioactive, chemical, or biological materials or accidental explosions, workers, members of the public, and the environment may be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their close proximity to the incident. The offsite public and co-located workers may also be at risk of exposure or effect to the extent that meteorological conditions exist for the atmospheric dispersion of released materials.

Documents prepared under the National Environmental Policy Act of 1969 (NEPA) should inform decision-makers and the public about chances that reasonably foreseeable accidents associated with proposed actions and alternatives could occur and about their adverse consequences. The term “reasonably foreseeable” extends to events that may have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason. “Credible” means having reasonable grounds for believability, and the “rule of reason” means that the analysis is based on scientifically sound judgment.

While the DOE *Recommendations for Analyzing Accidents under the National Environmental Policy Act* (DOE 2002) was archived in 2026, it was used as a guidance tool for preparing this accident assessment. The approach used in this SWEIS implements the Council on Environmental Quality's instruction that in environmental impact statements (EISs), agencies focus on important environmental issues and alternatives and discuss effects in proportion to their significance (DOE 2004a). As a result, the accident analysis in this SWEIS focuses on those activities or facilities that have the highest potential for health and safety impacts to the co-located worker or the offsite public.

D.3.1 Approach to the Analysis of Potential Accidents

For this SNL/NM SWEIS, the approach to the accident analysis was to examine the accidents that were evaluated in the 1999 SNL/NM SWEIS (DOE 1999), the facility-specific documented safety analyses (DSAs) or other safety-basis documents (e.g., safety assessments, hazards analyses [HAs]), the building emergency planning hazards assessments (EPHAs), and other documents that analyze SNL/NM accidents/hazards that have been prepared for current facilities and that determine potential impacts to the following (DOE 2002):

- three categories (involved workers, co-located workers, and the general public);
- the maximally exposed in each category and collective impact to each population; and

- the environment including biota and environmental media, such as land and water.

As indicated in Section D.2.1.8, the offsite MEI for normal operations is assumed to be located at the Kirtland Air Force Base (KAFB) Eubank Gate. This is consistent with previous annual measurements of offsite exposures. Under accident conditions, this SWEIS uses a term consistent with the DSAs, *maximally exposed offsite individual* (MOI), defined as a hypothetical person who receives the highest dose at or beyond the exclusion-area boundary for a 2-hour period during the passage of an airborne radioactive plume. The exclusion area boundary is closer to TA-V than the Eubank Gate and is discussed in Section D.3.5.4.

A simple, commonly used equation to calculate the radiological or chemical source term (ST) used in the accident analysis is:

$$ST = MAR \times DR \times ARF \times RF \times LPF \quad (\text{Equation D-1})$$

where:

- ST = The amount and form of radioactive or chemical material released to the environment under accident conditions.
- MAR = The amount and form of radioactive or chemical material at risk (MAR) of being released to the environment under accident conditions.
- DR = The damage ratio reflecting the fraction of MAR that is damaged in the accident and available for release to the environment.
- ARF = The airborne release fraction reflecting the fraction of damaged MAR that becomes airborne as a result of the accident.
- RF = The respirable fraction reflecting the fraction of airborne radioactive material that is small enough to be inhaled by a human.
- LPF = The leak path factor reflecting the fraction of respirable radioactive material that has a pathway out of the facility for dispersal in the environment.

However, certain accidents require more detailed and complex modeling than is provided with Equation D-1 (e.g., the evaporative source term following a chemical spill). In those cases, computer programs are used to calculate the source term, if needed. Section D.3.1.3 describes the computer programs used to calculate the source terms for relevant safety-basis documents used for this SWEIS. The equations used by these computer programs to calculate release may be found in the programs' documentation.

Next, the meteorological model is used to transport the source term from the release point to the receptor location. Numerous documents describe the various meteorological models (e.g., the U.S. Nuclear Regulatory Commission's [NRC's] Regulatory Guide 1.145 [NRC 1983] describes several variations of the Gaussian transport and dispersion model). Both the HotSpot (Homann 2010) and MELCOR Accident Consequence Code System, Version 2 (MACCS2) (DOE 2004b) computer codes use the Gaussian plume model to transport and disperse a release of radiological material to the atmosphere. Although the Gaussian model is relatively straightforward, the analyst must make several parameter assumptions, which can have a significant effect on the

magnitude of the calculated dispersion. These parameters include wind speed, atmospheric stability class, distance to the MOI, release elevation, plume buoyancy, terrain factors, building wake, wind direction, and off-centerline distance.

In this SWEIS, accident frequencies are generally grouped into the following four bins:

- *anticipated* (with estimated annual frequencies of greater than or equal to 1 in 100 [≥ 0.01]);
- *unlikely* (with estimated annual frequencies between 1 in 100 and 1 in 10,000 [≤ 0.01 to 0.0001]);
- *extremely unlikely* (with estimated annual frequencies between 1 in 10,000 and 1 in 1 million [≤ 0.0001 to 0.000001]); and
- *beyond extremely unlikely* (estimated annual frequencies less than 1 in 1 million [$\leq 1 \times 10^{-6}$]). These accidents are not considered reasonably foreseeable and were not considered further in this analysis.

Generally, frequencies lower than 0.0000001 (less than once in 10 million years) are not considered in NEPA documents (DOE 2002). Accident frequencies are based on the frequency of the entire event sequence, not just the initiating event. For example, an accident may be initiated by an event, such as human error (e.g., 0.1 per year), but in order for a hazardous material release to occur, that event must be followed by another event, such as the failure of a valve to close (e.g., 0.01 per year); thus, this hypothetical accident scenario has a frequency of 0.001 per year (i.e., 0.1×0.01). This approach for determining accident frequency is equivalent to that recommended by DOE-STD-3009 (DOE 2014) and ensures that this SWEIS is consistent with the SNL/NM safety-basis documents. In the description of the design-basis accidents (DBAs) considered in this SWEIS (Section D.3.5.1), the accident scenario frequency is the “unmitigated” frequency, which does not credit many of the active or administrative controls that would normally prevent the occurrence of an accident. This is conservative from a potential “risk” standpoint, because in many cases, the “mitigated” frequency of the event would be orders of magnitude lower.

D.3.1.1 Accident Scenarios Analyzed

As stated in Section D.3, an accident can involve a combined release of energy and hazardous materials (radiological, chemical, or biological) that might cause prompt or latent health effects. Therefore, this SWEIS postulated and analyzed the following five types of facility accident scenarios:

1. Radioactive Material Release (Section D.3.5)
2. Toxic Chemical Release (Section D.3.6)
3. Accidental Explosions of Energetic Materials (EMs) (Section D.3.7)
4. Biological Hazard Release (Section D.3.8)
5. Site-wide Multiple-Building Scenarios (Section D.3.10)

Site-wide multiple-building scenarios are accidents that could potentially involve more than a single SNL/NM facility, such as an earthquake or a wildfire.

In addition to the five types of facility accident scenarios listed in this section, this SWEIS discusses the potential for accidents that could occur during the onsite transport of material between SNL/NM facilities (Section D.3.9). Appendix E to this SWEIS addresses the potential impacts associated with offsite transportation.

Whenever possible, the accident scenarios presented in this SWEIS are based on scenarios that have been previously analyzed at SNL/NM. Documents consulted for these previous analyses include the 1999 SNL/NM SWEIS; the facility-specific DSAs, safety assessment documents (SADs), bases for interim operation (BIOs), and EPHAs; and calculations prepared by SNL/NM in support of these documents. Each of the documents consulted is identified in the following text and listed in the reference section at the end of this appendix (Section D.6).

Additionally, Chapter 3, Section 3.2, of this SWEIS provides information about the projects anticipated under the No-Action Alternative, and Chapter 3, Sections 3.3 and 3.4, provide information about projects proposed under the Modernized Operations and Expanded Operations alternatives, respectively. Each project, regardless of the alternative, was reviewed to determine whether updates to the information in the DSA or other safety-basis document analyses were necessary.

D.3.1.2 Facilities Included in the Analysis

Accident analyses have been performed at SNL/NM for decades, and safety-related documents have been prepared for the notable SNL/NM facilities that handle radiological, chemical, biological, or EMs. As shown in Table D-13, the safety-related documents include DSAs, SADs, BIOs, HAs, and EPHAs. These existing accident analyses form the basis for the selection of accidents included in this SWEIS.

Hazard Categories

Nuclear and radiological facilities are identified by a hazard category (HC), which relates to the potential consequences of an accident event (10 CFR Part 830). At SNL/NM, there are no HC-1 nuclear facilities, which are the type of nuclear facilities with the potential for significant offsite consequences. Rather, the nuclear facilities at SNL/NM are either HC-2 or HC-3. Facilities that handle less than HC-3 threshold quantities of radioactive materials are designated as “radiological facilities.”

Criteria for establishing the HC thresholds for SNL/NM facilities are based on DOE-STD-1027-92 (DOE 1997), along with NNSA’s supplemental guidance issued in 2011, *Guidance on Using Release Fraction and Modern Dosimetric Information Consistently with DOE-STD-1027-92*, NA-1 SD G 1027 (NNSA 1027 Supplemental Guidance) (NNSA 2011).

In 2018, DOE issued DOE-STD-1027-2018 (DOE 2019b) to take advantage of updated guidance and science used in the calculation of threshold quantities of radionuclides. As of the preparation of this SWEIS, SNL/NM facilities continue to operate under NNSA 1027 Supplemental Guidance. Section D.3.3 discusses the potential evolution of this standard and the effect on SNL/NM facilities.

Table D-13. SNL/NM Facility/Area Safety Documents Reviewed

Documented Safety Analysis (DSA), Basis for Interim Operation (BIO), Hazards Analysis (HA)
<i>Documented Safety Analysis (DSA) for the Annular Core Research Reactor (ACRR) Facility</i> (SNL 2024) The ACRR is discussed in more detail in Section D.3.5.1.
<i>Sandia Pulsed Reactor (SPR) Facility Documented Safety Analysis (DSA)</i> (SNL 2022b) The SPR is discussed in more detail in Section D.3.5.1.
<i>Basis for Interim Operation for the Auxiliary Hot Cell Facility</i> (SNL 2022c) The AHCU and Auxiliary Hot Cell Facility (AHCF) are discussed in more detail in Section D.3.5.1.
<i>Standalone Hazards Analysis for the Gamma Irradiation Facility</i> (SNL 2014) The primary operations carried out in the Gamma Irradiation Facility (GIF) are a variety of irradiation experiments using gamma radiation. Two primary types of irradiation experiments are performed at the GIF: in-cell dry irradiations and in-pool submerged irradiations. In-cell dry irradiations use sealed cobalt-60 sources enclosed in source-holding fixtures. In-cell dry irradiations may range from short-to-intermediate durations and are typically conducted at high-dose rates. Sealed cobalt-60 sources are also used for in-pool submerged irradiations; these tests may last from months to years. The GIF is a below HC-3 radiological facility.
<i>Radioactive and Mixed Waste Management Facility Hazard Analysis Document</i> (SNL 2018a) The RCRA-permitted RMWMU is the SNL/NM facility located in TA-III for managing radioactive and mixed waste. The HA addresses the entire Radioactive and Mixed Waste Management Facility (RMWMF), which includes adjacent structures located outside the fenced RMWMU. The primary hazards associated with the RMWMU/RMWMF daily operations are ergonomic issues associated with material handling (e.g., movement of waste containers) and exposure due to waste characterization, treatment, processing, and repackaging. There is also a risk of radioactive material release. During normal operations, the RMWMF is divided into four radiological segments for purposes of nuclear facility hazard categorization. The first three segments are part of the RCRA-permitted RMWMU: Segment 1 (Building 6920) is where the majority of the waste processing occurs; Segment 2 (Building 6921) is also used to process waste, but more specifically classified wastes; Segment 3 (Buildings 6925 & 6926, Transportainers 150 & 153) is used primarily for storage and staging for shipments; and non-RCRA-permitted Segment 4 (Sprung Structures, SP01, SP02, & SP03), located outside of the fence, is used for storage. The quantities of radioactive materials in each of the segments are kept below 90 percent of the HC-3 threshold quantities (TQs), and each of the four segments of the RMWMF is categorized as a below HC-3 radiological facility.
<i>Hazards Analysis for Thunder Range, What-If Checklist</i> (SNL 2022d) <i>Qualitative Risk Assessment for Site 9930, What-If Checklist</i> (SNL 2023b) <i>Standalone Hazards Analysis – Explosives Application and Containment Training Facility 9920 Complex, Rev. 1</i> (SNL 2020b) These HAs include a failure modes analysis of testing at various testing facilities on SNL/NM and evaluate the potential for hazards that could affect workers or the offsite public. Workers could be injured or killed in an accident; however, the offsite public would not be at risk during testing operations. The HAs identify that depleted uranium may exist on some ranges as fixed contamination. Testing on some ranges could include other radioactive materials such as fireset materials (nickel-63 and krypton-85); however, these materials are inaccessible to workers and could not be released in an accident. These facilities are not considered radiological facilities in accordance with DOE-STD-1027.

Documented Safety Analysis (DSA), Basis for Interim Operation (BIO), Hazards Analysis (HA)
<i>Radiological Work within the Tritium Envelope in Building 870 (SNL 2022e)</i> Building 870 in TA-I has been classified as a radiological facility with less than HC-3 quantities of material. The radiological hazard is mainly tritium, with an upper limit of 16,000 Ci and an organizationally imposed control level of 12,000 Ci. Targets with a tritium-containing hydride film, which are used in neutron tubes, are created, loaded, analyzed, and characterized in this facility.
Safety Assessment Document (SAD)
<i>Aerial Cable Safety Assessment (SNL 2022f)</i> The hazardous material inventory for the Aerial Cable Facility (ACF) includes both radiological and chemical components. The radiological inventories evaluated in the safety assessment include uranium that could be released during an accident and a list of controlled radiological sources used at the ACF. The chemical inventories include hazardous materials (e.g., beryllium [Be] and lithium [Li]) potentially released during an accident, and standard industrial chemicals used in ACF support operations. Radiological inventories are limited to 80 percent of the HC-3 TQs. The safety assessment determined the maximum quantity of radiological materials that could be released in an accident to be 40 grams of uranium and concluded that the radiological and/or toxicological consequences from a loss of containment event at the ACF would be negligible to both onsite and offsite receptors.
<i>Safety Assessment Document and Accelerator Safety Envelope for the High Radiation Examination Facility Linear Accelerator (SNL 2023c)</i> The High Radiation Examination Facility is located within TA-III. The facility houses electron accelerator experiments for new accelerator designs and electron accelerator experiments. A single accelerator type operates in the facility at any given time; the installed and operated accelerator performs routine radiation exposures designed to study incident electrons on various material targets, as well as using high-Z targets to produce very high energy x-rays, which are then used to interrogate targets. The SAD covers the use of a compact robust electron accelerator technology (CREATE) device that operates up to 35 megaelectron volts (MeV). Radiation exposures are performed in the concrete-shielded indoor high bay area that houses the accelerator and the exposure area. Other lower energy devices may be used in place of the CREATE linear accelerator. The SAD and accelerator safety envelope use the 35 MeV linear accelerator as the maximum energy, bounding device.
<i>Safety Assessment Document (SAD) for the HERMES III Accelerator Facility (SNL 2021c)</i> The only hazard presented by the High-Energy Radiation Megavolt Electron Source (HERMES) III accelerator facility, other than routinely accepted standard industrial hazards, is ionizing radiation having the potential for negligible impacts beyond controllable SNL/NM premises. Work can be performed safely, because the identified operational hazards (i.e., radiological exposure, fire, electrical shock, and oxygen deficiency) have been either eliminated or substantially mitigated by engineering and administrative controls. HERMES III poses negligible risk to the general public or the environment because (1) conservatively designed radiological shielding and stringent access control measures (and the substantial distance from the test area to any populated area) make public exposure to radiological hazards negligible, and (2) the basic containment provided by the building and the secondary containment for stored transformer oil are adequate to protect the public and the environment from hazardous materials. HERMES III provides protection for workers, the public, and the environment by operating in accordance with DOE Order 420.2D (DOE 2022b).

Documented Safety Analysis (DSA), Basis for Interim Operation (BIO), Hazards Analysis (HA)
<i>Rocket Sled Track Complex Safety Assessment (SNL 2011a)</i> The hazardous material inventory for the Rocket Sled Track (RST) includes both radiological and chemical components. The radiological inventories evaluated in the safety assessment include uranium that could be released during an accident and a list of controlled radiological sources used at the RST. The chemical inventories include hazardous materials (e.g., Be, Li) potentially released during an accident, and standard industrial chemicals used in RST support operations. Radiological inventories are limited to 80 percent of the HC-3 TQs. The safety assessment determined the maximum quantity of radiological materials that could be released in an accident to be 40 grams of uranium and concluded that, even if 40 grams of uranium were released during the worst-case accident scenario, the radiological consequences to all receptors would be negligible.
<i>Microsystems Fabrication Facility and Silicon Fabrication Facility Safety Assessment (SNL 2023d)</i> The Microsystems Fabrication Facility (MicroFab) and Silicon Fabrication Facility (SiFab) are part of the Microsystems Engineering, Science and Applications (MESA) Complex and are described in Section D.3.6.
Emergency Planning Hazard Assessment (EPHA)
<i>MESA Complex Emergency Planning Hazards Assessment (SNL 2021d)</i> The MESA Complex EPHA addresses potential hazards associated with hazardous chemicals that are stored and used in the following MESA Complex buildings: SiFab and MicroFab. The EPHA describes the atmospheric dispersion modeling of potential releases of hazardous materials and defines emergency action levels (EALs), protective action distances, and operational emergency classifications (refer to Section D.5).
<i>Technical Area-V Facility Emergency Planning Hazards Assessment (SNL 2019b)</i> The TA-V EPHA addresses hazards associated with operation of the ACRR, the AHCUR, and the SPR. These facilities are all discussed in more detail in Section D.3.5.1.
<i>Technical Area-V Facility Emergency Planning Hazards Assessment Temporary Order (SNL 2022g)</i> The Temporary Order addresses the same facilities included in the TA-V EPHA and updates information in the EPHA while that EPHA is being revised. Once revised, the Temporary Order will be replaced. These facilities are all discussed in more detail in Section D.3.5.1.
<i>Hazardous Waste Handling Unit/Transportation Emergency Planning Hazards Assessment (SNL 2021e)</i> This EPHA addresses potential hazards associated with Building 958 and Building 959 at the Hazardous Waste Handling Unit (HWHU) and potential onsite transportation incidents involving hazardous waste. The main mission for operations at the HWHU is the safe handling, storage, and shipment for final disposition of hazardous and other regulated waste and recyclable materials. Hazardous chemical waste is generated in each of the five SNL/NM TAs and transported to the HWHU on a routine basis. Hazardous waste is sent to the HWHU for packaging and storage prior to transportation offsite for recycling, treatment, or disposal at a permitted facility.

All documents in Table D-13, as well as other documents, were reviewed to select the facilities and accident scenarios to be included in this SWEIS. Most of the DSAs and safety assessments identify a complete spectrum of accidents, meaning that low-consequence/high-probability accidents, as well as high-consequence/low-probability accidents, and accidents in between, are considered and analyzed. For example, the ACRR DSA (SNL 2024) identified about 147 potential hazard events, but analyzed only those with the most severe consequences (e.g., the ACRR DSA analyzed 13 design-basis events [DBEs], plus five beyond-DBEs). The accidents selected for inclusion in this SWEIS were selected from the analyzed DBEs associated with the SNL/NM facilities that have the potential for offsite consequences. In some instances, potential accidents presented in this SWEIS are outside of the current DSA analyses (i.e., ACRR). The

potential accident consequences associated with ACRR experiments are based on the assumption of a higher provisional experiment material at risk (MAR) limit, which was evaluated as part of the Expanded Operations Alternative in the 1999 SNL/NM SWEIS (DOE 1999), and was then selected in the 1999 Record of Decision (64 FR 69996).

Based on the reviews of the existing safety-basis documents, NNSA identified all of the HC-2 and HC-3 facilities (per DOE-STD-1027-1992 [DOE 1997] and NNSA 1027 Supplemental Guidance [NNSA 2011]) at SNL/NM for further evaluation of potential accidents involving the release of radiological materials (refer to Table D-14).

Table D-14. SNL/NM Facilities with Radiological Materials Subject to Analysis

Technical Area	Building/Facility Description (Hazard Category)	Radionuclides Subject to Analysis	Source
TA-V	Annular Core Research Reactor Facility (ACRR) (HC-2) ^a	Fissionable material, fission products, tritium, activated byproducts	DSA (SNL 2024) 1999 SNL/NM SWEIS (DOE 1999)
TA-V	Sandia Pulsed Reactor (SPR) Facility (HC-2) ^a	Fissionable material, fission products, activated byproducts	DSA (SNL 2024)
TA-V	Auxiliary Hot Cell Unit (AHCU) (HC-3) ^b	Fissionable material, fission products, activated byproducts	BIO (SNL 2022c)
TA-V	Gamma Irradiation Facility (GIF) (<HC-3) ^c	Uranium, plutonium, cobalt-60	SNL 2014
TA-IV	High-Energy Radiation Megavolt Electron Source III (HERMES III) (<HC-3) ^{c, d}	Ionizing radiation	SNL 2021c
TA-I	Ion Beam Laboratory (<HC-3) ^c	Ionizing radiation, small quantities of various radionuclides	SNL 2011b
TA-I	Neutron Generator Enterprise + (NGE+) (<HC-3) ^c	Tritium, sealed radioactive sources	NTESS 2023b
TA-III	Radioactive and Mixed Waste Management Unit (RMWMU) (<HC-3) ^c	Uranium, plutonium, and other radionuclides	SNL 2018a
TA-III	High-Radiation Examination Facility (<HC-3) ^d	Ionizing radiation	SNL 2023c
TA-IV	Saturn Accelerator (<HC-3) ^{c, d}	Ionizing radiation	NTESS 2023b
TA-IV	Z-Machine (<HC-3) ^{c, d}	Ionizing radiation, tritium, and plutonium	NTESS 2023b

- These facilities are categorized as HC-2 facilities in accordance with NNSA 1027 Supplemental Guidance (NNSA 2011).
- These facilities are categorized as HC-3 facilities in accordance with NNSA 1027 Supplemental Guidance (NNSA 2011).
- These facilities have less than HC-3 TQs of radionuclides and are designated as radiological facilities (NNSA 2011).
- These facilities are operated in accordance with DOE Order 420.2D (DOE 2022b).

Potential impacts from accidents involving hazardous chemicals depend on the quantities of those chemicals that could be in an SNL/NM facility. Inventories of hazardous chemicals are based on SAND 2021-8639, Appendix C (SNL 2021b). Table D-15 presents the facilities evaluated for the potential release of hazardous chemicals.

Table D-15. SNL/NM Site Facilities with Chemicals Subject to Analysis

Technical Area	Building/Facility Description	Chemicals Subject to Analysis	Source
TA-I	MicroFab and SiFab (MESA Complex)	Numerous (refer to Section D.3.6)	SAD, EPHA (SNL 2021b, 2021c)
TA-II	HWHU	Numerous	EPHA (SNL 2021e)

DOE guidance recognizes this as an acceptable approach to NEPA accident analyses and refers to it as “bounding.” Specifically, the DSAs, SADs, BIOs, and/or EPHAs provide the initiating events, the accident frequencies (or frequency bin), the MAR, and the source term for each of the accident scenarios analyzed in this SWEIS. The applicable initiating event, accident frequency, MAR, and source term used in the analysis are provided in Sections D.3.5, D.3.6, D.3.7, and D.3.8 for the radiological, chemical, explosive, and biological HAs, respectively. Section D.3.9 discusses accidents associated with onsite transportation of radiological or hazardous material. Section D.3.10 describes the analysis of accident scenarios that could involve multiple buildings.

Thousands of containers of potentially hazardous chemicals are used in facilities at SNL/NM. Most of these contain very small quantities, and/or the materials are in a physical state that makes their accidental release to the atmosphere highly improbable (e.g., solids). Minor accidents such as a drop, spill, or equipment failure could cause the release of chemicals, resulting in localized impacts and potential risks to workers. These types of accidents are generally controlled or mitigated through administrative and engineering controls. Administrative controls include quantity limits, operating procedures, and spill response and cleanup protocols. Engineering controls that would mitigate the impacts of minor accidents include access control to chemical storage and laboratory areas, physical isolation of laboratory work areas, personal protective equipment, and fume hoods and other building ventilation controls.

For a minor accident in which a release is restricted to the building or immediate area, a range of consequences is possible: no impact to workers; skin contamination resulting in burns, rashes, or absorption of chemicals; or airborne exposure resulting in eye or lung irritation and/or near-term or long-term health effects from toxic chemicals. The analysis in this SWEIS focuses on those chemicals that have the potential for other than localized impacts. These consist of a relatively small set of toxic chemicals in a few locations that are in physical states such that their release to the atmosphere in quantities large enough to potentially injure members of the public or co-located workers would be plausible.

The largest user of hazardous chemicals at SNL/NM is the Microsystems Engineering, Science and Applications (MESA) Complex, where large quantities of chemicals are used to process semiconductors. As shown in Table D-15, SNL/NM has prepared an EPHA for the MESA Complex, which contains the chemicals with the most potential for affecting co-located workers and the public. The MESA Complex is located in TA-I. Similarly, the HWHU, located in TA-II, is the subject of an EPHA (SNL 2021e). Section D.3.6 discusses potential accident impacts associated with hazardous chemicals.

Energetic Materials (EMs) (Explosives). Many facilities or areas on SNL/NM use or store explosives (e.g., Explosives Components Facility, Explosives Assembly Building, Explosives

Test Facilities). Explosives safety is managed in accordance with DOE Technical Standard DOE-STD-1212-2019 (DOE 2019a). Section 12 of the standard provides level-of-protection criteria for personnel protection during explosives operations. The level-of-protection required for a given operation is based on the hazard class for a specific activity and its associated accident potential as opposed to a facility categorization. Based on these definitions, the hazard class of activities within an explosives facility or area could change multiple times within a single day. There are five hazard classes for explosives activities:

- Class 0** Explosives operations that involve the intentional initiation of explosive materials or articles (e.g., explosives testing, firing activities associated with training, destruction of explosives by detonation).
- Class I** Explosives operations that involve activities with a high accident potential where (1) energies approach the upper safety limits, (2) loss of control of interfacing energy is likely to exceed safety limits, and (3) the safety implications of research and development (R&D) have not been fully characterized. Examples include screening, blending, pressing, extrusion, drilling of holes, dry machining, machining explosives and metal in combination, some environmental testing, new explosives development and processes, explosives disposal by burning, and some destructive testing.
- Class II** Explosives operations that involve activities with moderate accident potential due to the explosives type, condition of the explosives, or nature of the operations. These activities involve energies that do or may interface with the explosives and are normally well within the safety boundaries for the explosives involved, but where the loss of control of these energies could approach the safety limits. Examples include weighing, some wet machining, assembly and disassembly, some environmental testing, and some packaging operations.
- Class III** Explosives operations that involve activities with low accident potential. Examples include activities during storage and operations incidental to storage or removal from storage.
- Class IV** Explosives operations that involve activities with insensitive explosives or insensitive explosives subassemblies where the probability of accidental initiation or transition from burning to detonation is negligible. Examples include processing and storage activities with insensitive explosives and insensitive explosives subassemblies.

In accordance with DOE-STD-1212-2019 (DOE 2019a), each explosives facility or area prepares an explosives safety site plan (ESSP). The ESSP establishes maximum net explosives weight limits, a clear zone around the explosives facility, and personnel limits for the explosives facility to mitigate the consequences of an accident. Explosives limits are monitored and managed in accordance with the requirements of Chapter 33, “Explosives Safety,” of the *ES&H Manual* (SNL 2023f), which incorporates DOE-STD-1212-2019 (DOE 2019a). With regard to potentially comingling radioactive materials and explosives, the Technical Standard states the following:

Explosives and hazardous radioactive materials (e.g., plutonium, enriched uranium) shall not be included in the same test or operation if the test or operation

is not contained and involves any of the following: application of high-energy stimuli (e.g., high shock, impact, or friction) to the explosive, heating the explosive to within 18°F (10°C) of the heating limit determined for the explosives system, and/or intimate contact of incompatible material with the explosive as determined by compatibility testing. Note: Depleted uranium and natural thorium are not considered hazardous radioactive materials for this purpose. Nuclear Explosive Operations, covered by DOE Order 452.2 are exempted from this requirement.

Because operations of explosive facilities or areas are controlled by the ESSP, the potential for impacts to members of the offsite public is extremely unlikely. However, in the event of human error and failure to follow the controls established in the ESSP, impacts could occur to nearby workers. These potential impacts could range from minor physical injuries to worker fatalities (refer to Section D.3.1.5).

D.3.1.3 Analytical Tools

DOE maintains a list of “toolbox” computer codes (i.e., analytical tools) that have been evaluated against DOE safety software quality assurance requirements of DOE Order 414.1D (DOE 2020b) and the safety software guidance in DOE G 414.1-4 (DOE 2010a). All analytical results presented in this section were determined by computer codes that are listed in the DOE toolbox, either specifically for this SWEIS or in a referenced document cited in this SWEIS.

Radioactive Material Release. For this SWEIS, two computer codes from DOE’s toolbox were considered appropriate for calculating impacts from an accident involving the release of radioactive materials: HotSpot¹¹ (Homann 2010) and MACCS2¹² (DOE 2004b). Both codes are similar in that they calculate doses to individuals based on the straight-line Gaussian plume dispersion and transport model. MACCS2 has been used to evaluate radioactive materials releases for SNL/NM DSAs, while HotSpot has been used for SWEIS development for other NNSA Weapons Laboratories (i.e., Lawrence Livermore National Laboratory and Los Alamos National Laboratory). Either code would be appropriate for performing analyses required for this SWEIS; however, HotSpot was chosen for this SWEIS, primarily due to its ease of use and to be consistent with recent SWEISs for other laboratories.

The HotSpot code does not directly calculate population doses associated with radioactive material releases but provides the projected atmospheric dispersion at selected distances and

¹¹ The HotSpot Health Physics Code is used for safety analysis of DOE facilities handling nuclear material. HotSpot V 2.07.1 includes a module that can be used to calculate the 95th percentile dose distribution for up to 20 radial centerline distances in each of 16 wind direction sectors using historical meteorological data input by the user. (Refer to *HotSpot Health Physics Codes, Version 2.07.1, User’s Guide*, Revision 1 [Homann 2010].)

¹² The MACCS2 code is based on the straight-line Gaussian plume model developed originally for NRC. MACCS2 evaluates doses and health risks from the accidental atmospheric releases of radionuclides. The principal phenomena considered in MACCS2 are atmospheric transport and deposition under time-variant meteorology, short-term and long-term mitigative actions and exposure pathways, deterministic and stochastic health effects, and economic costs. (Refer to DOE-EH-4.2.1.4 [DOE 2004b].)

directions from the release. Due to their similarity, the equations used to calculate the MOI and population doses were used to calculate the population dose using the HotSpot results. For example, the inhalation dose is calculated via:

$$D_{MOI} = \sum_{m=1}^m \left(ST_m \times \frac{X}{Q_{MOI}} \times BR \times DCF_m \right) \quad (\text{Equation D-2})$$

$$D_{Pop} = \sum_{m=1}^m (ST_m \times BR \times DCF_m) \times \sum_{k,n=1}^{k,n} \left(f_n \times \frac{X}{Q_{k,n}} \times P_{k,n} \right) \quad (\text{Equation D-3})$$

where:

DMOI	=	Calculated MOI dose (rem)
DPop	=	Calculated population dose (person-rem)
m	=	Number of radionuclides released
ST _m	=	MAR×ARF×RF×DR×LPF (Source term of radionuclide m released [e.g., Ci])
MAR	=	Material-at-risk (e.g., Ci)
ARF	=	Airborne release fraction
RF	=	Respirable fraction
DR	=	Damage ratio
LPF	=	Leak path factor
DCF _m	=	Radionuclide m inhalation dose conversion factor (rem/Ci)
BR	=	Breathing rate (cubic meters [m ³]/second)
X/Q _{MOI}	=	Atmospheric dispersion at the MOI location (seconds/m ³)
k	=	Offsite population distribution from SNL/NM in direction n at (0.5, 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, and 80 kilometers [km])
X/Q _{k,n}	=	Atmospheric dispersion at the distance k in direction n (seconds/m ³)
n	=	Offsite direction wind is blowing toward corresponding wind rose sector number 1–16
f _n	=	Frequency of wind blowing toward direction n
P _(k,n)	=	Offsite population at distance k and direction n (number of people)

For the MOI dose, D-2 shows that the radionuclide source term (ST_m) is multiplied by the dispersion factor to the MOI location (X/Q_{MOI}), which gives the concentration at the MOI location. That concentration is multiplied by the MOI's breathing rate, which gives the amount taken into the MOI's body. Finally, the amount taken into the MOI's body is multiplied by the dose conversion factor (DCF_m), which results in the dose to the MOI. This is repeated for each radionuclide and summed over all radionuclides to give the estimated MOI dose.

Mathematically, the above MOI dose equation is the same as Regulatory Guide 1.195, Equation 7 (NRC 2003).

The population dose equation (D-3) takes the individual dose at each downwind distance and multiplies it by the number of individuals at the distance. Because the wind direction at the time of the accident is unknown, for each distance, the population equation multiplies the population in each direction at that distance ($P_{k,n}$) by the probability that the wind is blowing in that direction (f_n) and then sums the products over all directions. The estimated 2020 population distribution across the 16 directional sectors around SNL/NM at distances from 0 to 80 kilometers (km) (0 to 50 miles) is derived from the 2020 U.S. Census and is shown in Table D-16. Sector numbers are used in the presentation of consequences tables (Table D-23, Table D-24, and Table D-25) later in this appendix.

Table D-16. Population Distribution Estimates within 80 km from SNL/NM, by Distance (km) from SNL/NM Site

Direction (sector #)	0.5 km	1 km	2 km	3 km	4 km	5 km	10 km	20 km	30 km	40 km	50 km	60 km	80 km
N (1)	0	203	1,517	3,764	2,334	2,916	33,848	51,370	18,909	15,893	82	53	667
NNW (2)	0	59	991	3,828	5,524	3,161	30,845	45,214	82,162	18,938	25	854	2,812
NW (3)	0	37	575	3,992	4,038	3,071	23,116	68,250	63,506	2,496	29	0	0
WNW (4)	0	350	248	2,014	5,207	3,782	28,195	85,793	530	131	19	231	250
W (5)	0	0	0	119	16	31	7,638	92,989	3,415	189	472	1,325	2,718
WSW (6)	0	0	0	0	0	0	66	21,035	239	12	3	197	1
SW (7)	0	0	0	0	0	0	534	2,546	5,447	15,184	131	6	3
SSW (8)	0	0	0	0	0	0	3	36	8,963	27,339	19,564	5,238	2,487
S (9)	0	0	0	0	0	0	0	7	3,647	200	11	248	156
SSE (10)	0	0	0	0	0	0	0	0	48	78	393	393	1,403
SE (11)	0	1	0	0	0	0	0	0	192	394	556	1,725	277
ESE (12)	0	1	55	685	476	104	3	566	3,098	1,583	2,359	665	71
E (13)	0	1	1	1,631	1,944	1,504	1,698	617	4,095	8,411	4,204	1,035	125
ENE (14)	0	30	140	3,826	4,179	4,354	4,398	2,847	8,206	2,398	268	133	66
NE (15)	0	78	672	2,092	3,625	4,188	18,476	343	2,453	247	164	1,095	41,049
NNE (16)	0	139	539	1,441	1,917	3,956	35,473	28,413	1,139	2,924	3,176	3,658	2,670
Total	0	899	4,738	23,392	29,258	27,067	184,291	400,026	206,047	96,418	31,457	16,857	54,756

[Direction wind is blowing from]: N: north; NNW: north northwest; NW: northwest; W: west; WNW: west northwest; WSW: west southwest; SW: southwest; SSW: south southwest; S: south; SSE: south southeast; SE: southeast; ESE: east southeast; E: east; ENE: east northeast; NE: northeast; NNE: north northeast.

Source: Developed based on 2020 U.S. Census data. The 2021 ASER indicates that the population within 80 km (50 miles) of SNL/NM was 1,075,720 (SNL 2023a).

All population doses presented in this SWEIS were based on that population distribution. The populations within this 80-km radius are expected to continue to increase by about 0.7 percent per year, reaching over 1,219,000 people by 2040. If the population increase is assumed to be uniform across all distances and directions, then these population increases would result in a corresponding approximate 13 percent increase in the total population dose by 2040. It is noted that the exact increase in the population dose would ultimately depend on where the increased population is located.

The meteorological data came from Meteorological Tower A36 located nearest to TA-V. The data files for 2018–2022 (SNL 2023e) were used to develop average wind speeds in each

direction and the associated stability classes, which were inputs to the HotSpot code to determine potential radiological doses for this SWEIS, as discussed in Section D.3.1.4.

Toxic Chemical Release. Two computer codes from DOE’s toolbox have been used to calculate the potential impact from a toxic chemical release accident: Areal Locations of Hazardous Atmospheres (ALOHA) (EPA 2016) and EPIcode (DOE 2004c). DOE/NNSA has used both codes in past analyses for safety-basis documents, as well as for preparation of SWEISs. The ALOHA code was used during the preparation of the safety assessment for the MESA Complex (SNL 2021d and SNL 2023d).

Biological Hazard Release. Bioscience research activities at SNL/NM are currently conducted in biosafety level (BSL) 1 and BSL-2 facilities and are categorized as low-hazard and non-nuclear. BSL-1 and BSL-2 laboratories that include limited work with potentially infectious microorganisms are regulated by the Centers for Disease Control and Prevention, National Institutes of Health, SNL/NM’s Institutional Biosafety Committee, and the Institutional Biosafety Officer.

Site-Wide Multiple-Building Scenarios. Consequences for the site-wide seismic event were analyzed using the same tool discussed for radioactive material release (i.e., HotSpot) and for chemical releases in the EPHA for the MESA Complex (SNL 2021d). Section D.3.10.2 discusses the potential for site-wide wildfire events.

D.3.1.4 Meteorological Assumptions

Several meteorological assumptions are necessary to perform the accident analyses, including wind speed, atmospheric stability class, distance to the MOI, release elevation, plume buoyancy, terrain factors, building wake, wind direction, and off-centerline distance. These meteorological assumptions primarily apply to the radiological dispersion modeling performed specifically for this appendix. In some cases, the appendix presents results from other safety-basis documents, which may make slightly different assumptions, depending on when the analysis was performed.

Wind Speed and Atmospheric Stability Class. DOE Order 151.1E (DOE 2024), states that, for the purposes of emergency planning, accident impacts should be calculated under conservative and average dispersion conditions. Based on this guidance and 5 years of SNL/NM site meteorological data (i.e., 2018–2022) (SNL 2023e), it was found that for ground-level releases, the conservative case corresponded to F stability class and a wind speed of 1 meter per second (m/sec) (2.2 miles per hour). The 2018–2022 average meteorological data corresponded to C stability class and 3.59 m/sec wind speed (8 miles per hour); however, the average dispersion conditions vary widely over the wind directions with wind stability ranging from B to D stability class and wind speeds of 2.07–5.90 m/sec (4.6–13.2 miles per hour). Therefore, the average wind speeds and stability classes used for accident calculations were based on the averages for each wind direction.

Distance to the MOI. The SNL/NM site covers about 26 square miles (16,532 acres) and has buildings located at various TAs on the site. The MOI is a hypothetical individual who is assumed to remain at a public access area for at least 2 hours after an accident. All of the HC-2 and HC-3 buildings are in TA-V. The DSAs for the HC-2 facilities define the exclusion area

distance as 1,350 meters from the facilities. For the DSAs and for this SWEIS, the closest MOI location is assumed to remain at the boundary of this exclusion area.

For this appendix, consistent with the SNL/NM safety-basis documents, the co-located worker is assumed to be 100 meters from the accident or release location.

Wind Direction and Horizontal Off-Centerline Distance. For the MOI and the co-located worker, it was assumed that the wind was always blowing directly toward the individual (i.e., both individuals are located on the centerline). As described in Section D.3.1.4, for the determination of potential population impacts, each sector's population was weighted by the annual frequency at which the wind blows toward the sector.

Terrain Factors and Building Wake. To determine atmospheric dispersion, the Pasquill-Gifford horizontal and vertical diffusion coefficients (commonly referred to as σ_y and σ_z , respectively) are important and are based on the specific meteorological data for 2018–2022.

For accidents involving TRU radionuclides, DOE-STD-5506 (DOE 2021b) specifies use of the standard or rural diffusion coefficients, unless there is specific justification for using the urban or city coefficients. Since TA-V is centrally located on the site and generally isolated from other, more developed areas of SNL/NM, the more conservative standard or rural diffusion coefficients were used for all SNL/NM analyses.

The SWEIS radiological accident analyses did not take credit for enhanced dispersion caused by the building wake.

D.3.1.5 Worker Impacts

In all accidents, there is a potential for injury or death to workers in the vicinity of the accident. Potential health effects become increasingly difficult to quantify as the distance between the accident or release location and the worker decreases because the exposure cannot be adequately established with respect to the presence of shielding and other protective features. The worker also may be injured or killed by physical effects of the accident.

Explosions could result in immediate injuries or death from flying debris, as well as the uptake of radioactive particulates through inhalation. If a criticality occurred, workers in the immediate vicinity could receive high to fatal radiation exposures from radiation bursts. The radiation dose strongly depends on the number of fissions, the distances of the exposed workers from the criticality, and the amount of shielding provided by structures and equipment between workers and the accident. While an earthquake with subsequent fire could also have substantial consequences ranging from workers being killed by debris from collapsing structures to high radiation exposure and uptake of radionuclides, the probability of such an event occurring at SNL/NM is less than once in 2,500 years (refer to Section D.3.10). Reactor and accelerator operations pose potential hazards to workers due to exposure to radiation and inhaled radioactive and hazardous materials. However, SNL/NM has many controls, including passive structural shielding, venting requirements, and exclusion areas, that mitigate and limit these hazards.

For most accidents, immediate emergency response actions would likely reduce the consequences for workers near the accident. Established emergency management programs would be activated in the event of an accident (refer to Section D.5).

D.3.2 No-Action Alternative Project Accidents

The No-Action Alternative would use existing capabilities to continue current, ongoing operations to support NNSA programs and would proceed with projects or activities that have been approved or are in the process of being approved for implementation, as described in Chapter 3, Section 3.2, of this SWEIS. For this section, each of the projects in Chapter 3, Table 3-1, was reviewed to determine whether the consequences from a radiological, chemical, biological, or explosive accident resulting from the project could potentially have greater consequences than the previous analysis of the existing buildings and facilities. Many of the No-Action Alternative projects involve infrastructure improvement and similar projects, which by their nature would not result in any potential for a radiological, chemical, biological, or explosives accident. However, there are three No-Action Alternative projects for which that conclusion is not intuitively obvious; those projects are discussed as follows.

Increased Provisional Experiment Limit at ACRR. The 1999 SNL/NM SWEIS (DOE 1999) evaluated an increase in the provisional experiment MAR limit of ACRR for experiments involving plutonium (Pu)-239. The potential consequences of an accident involving an experiment with this higher limit were evaluated in the 1999 Safety Analysis Report for ACRR and were included in the 1999 SWEIS (SNL 1999 and DOE 1999). The accidents presented in Section D.3.5 include this higher provisional experiment MAR limit. Implementation of this higher limit would only occur after revision and approval of the ACRR facility DSA (SNL 2024).

Power Sources Capability Facility. SNL/NM will construct the facility in TA-II to replace an existing facility. As a replacement facility, the hazards and risks are expected to be no greater than those of the existing facility. The replacement facility will be categorized as a “low hazard, non-radiological” facility in accordance with NNSA 1027 Supplemental Guidance (NNSA 2011). The impacts associated with the facility are bounded by the analyses performed for HC-2 and HC-3 facilities and are not analyzed further in this SWEIS.

Energetic Manufacturing Science and Technology Facility. This facility will support expertise in explosive materials and component design, evaluation and production, performance and exploratory tests of explosives and explosive components, explosive diagnostics testing, and non-explosive machining operations. As described in Section D.3.1.2, the facility will be operated in accordance with DOE-STD-1212-2019 (DOE 2019a) and has an approved ESSP with established explosives mass limits and limits on the number of personnel who can be in the facility. The facility will not increase the risks to the offsite public from explosives.

D.3.3 Modernized Operations Alternative Project Accidents

The Modernized Operations Alternative continues existing programs and activities by modernizing facilities, as necessary. This alternative combines the scope of the No-Action Alternative with additional modernization activities including replacement facilities, upgrades to

existing facilities, and additional DD&D projects. This alternative would not expand capabilities and operations beyond those that currently exist. The new facilities, modernization/upgrade of existing facilities, upgrades of utility and infrastructure, and additional DD&D projects are identified in Chapter 3, Table 3-3, and described in Chapter 3, Section 3.3, of this SWEIS. For this section, NNSA considered each of these projects to determine whether a radiological, chemical, biological, or explosives accident resulting from the project could potentially have greater consequences than shown in the previous analysis of existing buildings and facilities. Many of the Modernized Operations Alternative projects involve infrastructure improvement and similar projects, which by their nature would not result in any potential for a radiological, chemical, biological, or explosives accident. Accident impacts of the replacement and upgraded facilities are bounded by the accidents analyzed in this SWEIS since the amount of material available for an accident would remain the same and there are no significant differences in the operations of the replacement facilities. However, that conclusion is not intuitively obvious for several projects, which are discussed as follows.

Energetics Components Capability. As noted in Chapter 3, Section 3.3.1, the proposed project would recapitalize the Explosive Components Facility. The project would include light labs, explosives labs, battery testing lab, explosive rapid prototyping, neutron generator assembly/test areas, gas gun facility, explosives firing chambers/pads, and explosives receiving/storage. No notable differences in accident risks/consequences are expected compared to existing facility risks/consequences. The facility would be operated in accordance with DOE-STD-1212-2019 (DOE 2019a). Any changes that modify the facility footprint or modify approved explosives limits would require a new ESSP.

Neutron Generator Enterprise+ (NGE+). NGE is an existing less than HC-3 facility in TA-I with operations spread across eight buildings in multiple locations. Under the Modernized Operations Alternative, consolidation of these operations would improve workflow and efficiency, benefiting neutron generator R&D, design, and production. As identified in Chapter 3, Section 3.3.1, the tritium administrative limits¹³ for NGE+ are expected to be the same as those for the existing facilities, and no notable differences in accident risks/consequences are expected compared to existing facility risks/consequences. Impacts associated with the proposed facility would be bounded by the analyses of the existing facilities and are not analyzed further in this SWEIS (SNL 2022e).

Full Replacement of Saturn and HERMES. Saturn and HERMES are two unique, pulsed-power-based, high-current/high-energy accelerators that are categorized as radiological facilities (<HC-3) in accordance with NNSA 1027 Supplemental Guidance (NNSA 2011). Both facilities are proposed to be replaced. The new facilities, which would continue to function as radiological facilities, would be about the same size as the existing facilities. A new technology platform is proposed for cold x-ray testing, but no additional hazards external to the facility are expected. Small quantities of very short half-life radiological gases would be emitted during normal operations, which would be similar to existing operations. Additionally, improvements in safety are expected because of lessons learned and the expanded use of engineered controls as opposed

¹³ Administrative limits are 16,000 Ci for the site, with a control limit of 12,000 Ci.

to administrative controls. As a result, accident risks/consequences are anticipated to be less than those for the existing facilities. Future operations of these facilities would be managed in accordance with SD 1027 and DOE Order 420.2D, as appropriate.

Z-machine Operations. As described in Chapter 3, Section 3.4.3, NNSA proposes to transport some TRU waste from Z-machine operations to Idaho National Laboratory for waste reduction and recycling before eventual transport to the Waste Isolation Pilot Plant for disposal. Continued operation of the Z-machine, a radiological (<HC-3) facility, would be unaffected by the change in operations. Appendix E to this SWEIS addresses the potential increase in transportation risks.

ACRR Fuel Recladding. Fuel recladding would support ACRR operations until that facility is replaced. The recladding effort would be expected to occur at an existing facility in TA-V such as the AHCU until other facilities become available. The potential recladding activities would be performed in accordance with the TQs of radionuclides for the hazard categorization for the facility. Therefore, if recladding were performed in the AHCU, the facility would not exceed HC-3 TQs and thus not exceed the potential consequences identified in Section D.3.5 for the AHCU. If recladding were to occur in a new hot cell integral to the proposed CREST nuclear facility, accidents would be bounded by the potential accidents for that HC-2 facility as identified in Section D.3.5.

Additional ACRR Tests/Activities. NNSA proposes that the ACRR could increase the number of test activities it conducts annually under the Modernized Operations Alternative. While this change could impact other environmental resource areas, it would not affect accident consequences or risk. The increased number of tests would not result in a noticeable change to the estimated frequency range for the accidents evaluated in this SWEIS. Therefore, this change would be bounded by the accident risks presented in Section D.3.5.1.

Changes in Radionuclide Quantities in SNL/NM Nuclear and Radiological Facilities. As noted in Chapter 3, Section 3.2.2, DOE nuclear and radiological facilities are categorized as HC-1, HC-2, HC-3, or below HC-3 based on TQs of radionuclides that are authorized to be within that facility. The TQs are defined in DOE-STD-1027. Currently, the nuclear facilities at SNL/NM operate in accordance with DOE-STD-1027-92 (DOE 1997), and NNSA 1027 Supplemental Guidance (NNSA 2011) TQs. In 2018, DOE-STD-1027 was revised (DOE 2019b) to take advantage of updated guidance and science used in the calculation of TQs of radionuclides.

DOE is in the process of implementing the Defense Nuclear Facilities Safety Board's Recommendation 2020-1, *Nuclear Safety Requirements*. As part of that implementation, on March 8, 2023, DOE notified the Board of the Department's intent to develop a single, updated, and consolidated hazard categorization standard and seek to incorporate it by reference in 10 CFR Part 830 as part of a rulemaking (DOE 2023e). This updated standard will represent the single, acceptable methodology for future or updated hazard categorizations of DOE nuclear and radiological facilities. On June 13, 2023, DOE provided a justification for its proposed approach (DOE 2023f).

In light of these evolving standards and the TQs by which SNL/NM manages its facilities, Section D.3.5.2 of this SWEIS addresses the potential impacts associated with operating the facilities with revised TQs of radioactive elements.

D.3.4 Expanded Operations Alternative Project Accidents

The Expanded Operations Alternative includes the actions in the Modernized Operations Alternative plus actions that would expand operations and missions to respond to future national security challenges and meet increasing requirements. This alternative would expand capabilities at SNL/NM beyond those that currently exist. The new facilities and utility and infrastructure projects are identified in Chapter 3, Table 3-5, and described in Chapter 3, Section 3.4, of this SWEIS. For this section, NNSA considered each of these projects to determine whether the consequences from a radiological, chemical, biological, or explosives accident resulting from the project could potentially have greater consequences than the previous analysis of existing buildings and facilities. Most of the Expanded Operations Alternative projects involve new infrastructure or expansion of existing capabilities that would not result in any increased potential for a radiological, chemical, biological, or explosives accident. The following provides a specific evaluation of the other Expanded Operations projects.

Combined Radiation Environments for Survivability Testing (CREST) Complex. NNSA proposes to construct and operate the CREST Complex, which is intended to replace and expand the ACRR's and AHCU's capabilities in the next 10–15 years. The CREST Complex would be located in TA-V and include the CREST nuclear facility, which would be an HC-2 facility. Primary activities addressed in the Pre-Conceptual Hazards Analysis prepared for CREST (SNL 2018b) include (1) experiment operations, (2) reactor operations, (3) reactor maintenance, (4) facility maintenance and operations, (5) experiment handling and storage, (6) fuel handling and storage, (7) accelerator operations, and (8) hot cell operations. The proposed CREST nuclear facility has passed the Critical Decision-0 phase and the subsequent Analysis of Alternatives, and is now engaged in the process of Conceptual Design in accordance with DOE Order 413.3B (DOE 2023c). Section D.3.5.3 discusses the potential accident scenarios involving radioactive materials associated with the CREST nuclear facility.

Expansion/Upgrades of the Radioactive and Mixed Waste Management Unit. NNSA has proposed expansion of the RMWMU to provide upgrades, ventilation, and reconfiguration of space to accommodate additional personnel and areas for processing of additional waste. Although additional waste quantities would be processed through a larger facility, the RMWMU would remain a radiological facility (<HC-3). Impacts associated with the proposed expansion would be bounded by the analyses performed for HC-2 and HC-3 facilities and are not analyzed further in this SWEIS.

Next Generation Pulsed-Power (NGPP) Facility. The NGPP Facility would be a pulsed-power facility that would replace/enhance the Z-machine complex, which is scheduled for DD&D if the NGPP Facility is constructed. Like the Z-machine, the proposed NGPP Facility would be designated as a radiological facility (<HC-3). Impacts associated with the proposed facility would be bounded by the analyses performed for HC-2 and HC-3 facilities and are not analyzed further in this SWEIS.

Increased Z-machine Operations. Under the Expanded Operations Alternative, NNSA proposes to increase the number of experiments at the Z-machine by about 50 percent. NNSA notes that the proposed NGPP Facility would be a replacement for the Z-machine; thus, the Z-machine operations might not be expanded if NNSA decides to proceed with the NGPP. Under the increased operations, the Z-machine would continue to manage its inventory such that it stays below the HC-3 TQs of radionuclides. Therefore, it would remain a radiological facility (<HC-3), and potential impacts would be bounded by the analyses performed for HC-2 and HC-3 facilities and are not analyzed further in this SWEIS.

Microreactor or Small Modular Reactor. As discussed in Chapter 3, Section 3.4.2, SNL/NM proposes to integrate up to 50 megawatts of advanced nuclear power technologies into the KAFB and SNL/NM energy portfolio. For each instance, a factory-manufactured, fully assembled, and pre-fueled microreactor or small modular reactor between 5 and 10 megawatts electric would arrive at SNL/NM and would be connected to the electric grid. Microreactors are self-regulating and do not rely on engineered systems to ensure safe shutdown and removal of decay heat. Potential accident scenarios could arise leading to fission product release; however, the overall risk profile of these very low power reactors is generally considered to be low because of the many passive heat sinks to which residual decay heat could be dissipated.

While NNSA has not identified a particular design for a microreactor or small modular reactor at SNL/NM, there are existing analyses of hazardous and radioactive material release impacts associated with a microreactor within the DOE Complex. The U.S. Department of Defense (DoD) and DOE issued a Record of Decision for the Pele Project Final EIS (DoD 2022) on April 15, 2023 (87 FR 22521). The Pele microreactor would be located at the Idaho National Laboratory. This is only one example of an evaluation of potential hazardous and radioactive material release impacts. Given the relatively early planning stage for this type of project, the Pele Project Final EIS can serve only as an example for future planning purposes. From the perspective of the SNL/NM site, any microreactor or small modular reactor deployment must satisfy dose criteria at the site boundary for the proposed location of the facility. A microreactor facility that has the potential for significant onsite consequences but steady-state power levels below 20 MW thermal could potentially be classified as HC-2. Such a facility would have sufficient nuclear material for a nuclear criticality event to be possible and require onsite emergency planning activities. The extent of radiological consequences for an HC-2 facility should not exceed 1 rem at 100 meters. A requirement for siting a microreactor at SNL/NM would be that the accident consequences would be bounded by existing safety analyses for ACRR and Sandia Pulsed Reactor Facility/Criticality Experiments (SPR/CX) facilities. As noted in the Project Pele EIS, this requirement could be achievable, though detailed design would be required to ensure the adequacy of the safety design for the specific facility.

Similar to the future potential siting requirements and decisions identified previously in this section, there would also be requirements that onsite transportation accidents involving the microreactor should not exceed offsite consequences currently analyzed for the ACRR.

Siting requirements for a microreactor or small modular reactor at SNL/NM would be developed such that the accident consequences would be bounded by existing safety analyses for ACRR and SPR/CX facilities; therefore, the potential accident impacts associated with this project

would be bounded by the previous analyses and radiological consequences associated with ACRR and SPR/CX facilities presented in Section D.3.5.1.

D.3.5 Accident Scenarios Involving Radioactive Material

Facilities at SNL/NM play vital roles in NNSA missions, including enhancing U.S. national security; maintaining and enhancing the safety, reliability, and effectiveness of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test, in order to meet national security requirements; promoting international nuclear safety and nonproliferation; reducing global danger from weapons of mass destruction; and supporting U.S. leadership in science and technology.

Several of the facilities use radioactive materials in a wide variety of operations including scientific and weapons R&D and production, diagnostic research, research on the properties of materials, machining and inspection, chemical processing, analytical chemistry, metallurgy, weapon component processing, and as calibration and irradiation sources. Radioactive materials are collected as waste products in forms varying from contaminated laboratory equipment and metal filings to contaminated trash and liquids. Radioactive materials are transported and managed onsite. Therefore, there is a potential for releases of radioactive materials due to human error; failure or malfunctioning of equipment; accidents during the treatment, handling, or transportation of radioactive wastes; and severe natural events like earthquakes or wildfires.

Accident scenarios involving radioactive materials were evaluated for each alternative (No-Action, Modernized Operations, and Expanded Operations) and are presented in the following sections.

D.3.5.1 No-Action Alternative Radiological Accident Scenarios

As indicated in Section D.3.1.2, some of the SNL/NM facilities presented in Table D-14 include quantities of radioactive material above HC-3 thresholds and warrant further analysis. The No-Action Alternative will use these existing facilities and their capabilities to continue current, ongoing operations and will proceed with projects that have been approved or are in the process of being approved for implementation. The DSAs and other safety-basis documents for these facilities/activities provide information on the types of radioactive material contained in each facility. The central focus of the DSAs and other safety-basis documents is to provide reasonable assurance that the facility can be operated safely with respect to workers, the public, and the environment. Consistent with their purpose, source terms and other assumptions used to develop accident frequency and consequence estimates in the safety-basis documents are conservative (usually very conservative). NNSA expects that the actual risk of the facility operations will be much lower than portrayed in the safety-basis documents. For this SWEIS, these safety-basis documents are the foundation of the frequencies and consequences presented. However, to estimate doses, in some cases, NNSA applies more realistic assumptions, such as the application of passive controls. Additionally, the radiation dose estimates in the DSAs were determined using a different dispersion model. As reported in Section D.3.1.3, the analysis in this SWEIS used the HotSpot code. For these reasons, the radiation doses presented in this SWEIS may not be identical to those presented in the safety-basis documents. However, they are considered to be realistically conservative estimates of radiation doses that could result under accident conditions.

Based on the information from the SNL/NM safety documents, this SWEIS selected six DBAs associated with SNL/NM facilities and their operations for further analysis of potential radiological accident scenarios. Table D-17 presents these DBAs, followed by the results of the DBA analyses.

Table D-17. DBAs for the Evaluation of Radiological Accident Scenarios

Accident Identifier	SNL/NM Facility	Accident Scenario Description
DBA-1	ACRR	Control rod bank inadvertent withdrawal that results in major fuel damage
DBA-2	ACRR	Pulse/transient rod withdrawal (TRW) experiment malfunction that results in significant vaporization
DBA-3	ACRR	Full-facility fire
DBA-4	SPR	Full-facility fire during critical experiment
DBA-5	SPR	Excessive reactivity during critical experiment
DBA-6	AHCU	Facility fire

The rationale for selecting these SWEIS DBAs is described as follows.

Annular Core Research Reactor Facility

The ACRR provides neutron and gamma radiation environments in either pulsed or continuous operation modes to perform experiments, including component electronics testing. Under the No-Action Alternative, the ACRR will continue to perform as it currently does. At the ACRR, the primary safety features include a core that would remain intact even if completely exposed to air, as well as a very large pool of water that extends about 20 feet above the top of the core to provide shielding from direct radiation from the core and limit the amount of fission products that would be released to the room environment, even in a major accident that caused the cladding on some of the fuel to fail and release fission products to the surrounding water.

The ACRR is a research or test reactor designed such that experiments and test articles can be placed within the annular core region of the reactor and subjected to high-intensity pulses or longer term, low-power irradiation. Test items can also be subjected to explosives while in this annular core region of the reactor. Limits are placed on the quantity of explosives and radioactive materials that can be used within the test area and the building to ensure that ACRR operation meets DOE's requirements. The technical safety requirements state the limits, which are based on evaluation of hazards in the DSA.

Experiments containing fissionable material can be irradiated in the ACRR. For experiments containing only plutonium, the dominant radionuclide hazard is the plutonium itself, rather than fission products produced. A maximum of 20.6 kilograms (kg) of Pu-239 equivalent was assumed for accidents involving the inventory in facility storage with applicable/realistic fractions of Pu-239 equivalent assumed for accidents involving experiments. The 20.6 kg quantity (and portion thereof specifically attributable to experiments) is referred to as the provisional limit(s), which ultimately requires DOE authorization and is thus expected to rarely occur. Normal administrative MAR limits are a maximum of 2 kg of Pu-239 equivalent inventory in the facility and 5 grams of Pu-239 equivalent for an experiment. Although experiments may contain tritium, the ACRR does not perform experiments that contain

significant quantities of both plutonium and tritium at the same time. The maximum facility limit for tritium is 500 Ci.

The ACRR DSA evaluates 13 DBAs, including operational accidents, aircraft crash, and earthquake, as well as 5 beyond-DBAs. Review of the DSA accident evaluation indicated that the primary contributor to offsite dose from an accident would be a malfunction that results in failure of an experiment and vaporization and release of plutonium from the experiment to the room and atmosphere. Fission products from the ACRR fuel, other than noble gases, would be primarily constrained by the fuel matrix and pool water; only an insignificant fraction would make its way to the room or atmosphere (SNL 2024).

Of the 13 DBAs in the ACRR DSA (SNL 2024) or the 1999 SNL/NM SWEIS (DOE 1999), 3 were selected to represent and bound all other postulated accidents. They provide a spectrum of potential accidents involving ACRR operations. DBA-1 involves a potential reactor excursion resulting in fuel damage. DBA-2 reflects a possible equipment malfunction resulting in the vaporization of the materials involved in the experiment, while DBA-3 represents a full-facility fire. Section D.3.10 addresses the potential site-wide consequences of a seismic event involving the ACRR.

DBA-1 involves the inadvertent withdrawal of a control rod, allowing the reactor to reach steady-state operation after an excursion. The accident scenario would cause the uranium dioxide-beryllium oxide (UO₂-BeO) or uranium zirconium hydride (UZrH) fuel to reach its melting temperature and result in damage to the stainless-steel cladding. The DSA assigned the initiating event for this scenario an unmitigated frequency of “anticipated” (>0.01 per year) and a mitigated frequency of “beyond extremely unlikely” for the scenario as a whole (the excursion would not result in fuel melt or cladding damage). Although this SWEIS does not credit operator or hardware intervention, it does appropriately apply passive design features, such as the ACRR pool water, fuel element and reactor core designs, and control rod withdrawal speed, to derive a scenario frequency of “extremely unlikely” (≤0.0001 to 0.000001 per year) and uses the midpoint (0.00001) to calculate risk. DBA-1 represents an unmitigated accident since the scenario ignores operator or hardware intervention to stop the excursion. The MAR for this accident assumes that all fuel elements in the ACRR core and 15 percent of the Fuel-Ringed External Cavity (FREC)-II core¹⁴ reach the melting temperature and incur cladding damage. This assumption accounts for potential releases associated with the material involved in an experiment.

DBA-2 represents the highest consequence, unmitigated, operational accident reported in the ACRR DSA. The “experiment malfunction – pulse/transient rod withdrawal (TRW) irradiation” accident scenario evaluates the range of pulse/TRW experiments containing limited quantities of fissionable material that may be conducted at the ACRR.

¹⁴ The FREC-II is an experiment facility external to the ACRR core that can be coupled to the ACRR or decoupled while still remaining in the ACRR pool. The FREC-II core uses UZrH fuel. FREC-II cannot become critical by itself when coupled to the ACRR core.

The source term associated with an experiment is a function of the category of material, component, or system being irradiated. Using the category approach, the bounding potential source term would be associated with an experiment involving fissionable material. Typically, the quantity of fissionable material associated with these types of experiments is below 1 gram of Pu-239 equivalent; however, the ACRR has a DOE-directed experiment MAR limit of 5 grams of Pu-239 equivalent. Experiments can exceed the 5-gram limit with NNSA Sandia Field Office (SFO) approval of each specific experiment. The current DSA accordingly evaluates a provisional experiment MAR limit with a quantity of Pu-239 equivalent of 400 grams. The 1999 Safety Analysis Report and the 1999 SNL/NM SWEIS evaluated the potential impacts of a provisional experiment MAR limit higher than that evaluated in the current DSA. The DBA-2 accident analyzed in this SWEIS assumes the same provisional experiment MAR limit from 1999 (SNL 1999 and DOE 1999). The potential consequences of an unmitigated release of the assumed inventory of vaporized plutonium require two controls to mitigate potential offsite consequences. One, fissionable materials must be emplaced inside/within an experiment-containment apparatus. The experiment containment also has specific performance criteria stipulated in the DSA. Leak-tightness of experiment containment must be verified on an experiment-specific basis, and generally is required to be less than 1 volume percent over a time period of 8 hours. This ensures that less than 1 percent of the potential radionuclides are released from the containment apparatus in the event of an accident. The second control that is specified in the DSA is experiment thermal neutron shielding.

For experiments with greater than 12 grams Pu-239 equivalent actinides or other fissionable materials, boron-loaded shielding or equivalent thermal neutron shielding material must be installed as part of the experiment package shielding the MAR during irradiation. The boron-loaded shielding material will have shielding properties sufficient to limit vaporization of MAR to less than or equal to 12 grams Pu-239 equivalent for all experiments. Various thickness and natural boron density combination materials may be used to meet this requirement. Other shielding materials and/or spectrum modifying materials (e.g., buckets with moderating properties) may be used if the experiment package provides equivalent or more effective shielding properties to prevent vaporization of more than 12 grams Pu-239 equivalent of MAR.

The specific MAR associated with this accident scenario was assumed to be:

- much greater than 5 grams of Pu-239 equivalent,
- fission products from 1×10^{17} fissions, and
- 500 Ci of tritium.

The DSA assigned an unmitigated frequency of “anticipated” (>0.01 per year) to the initiating event for this scenario. This SWEIS applies passive design features, such as experiment containment (fissile material completely contained in a non-oxidizing atmosphere) and experiment thermal neutron shielding (thermal neutronic decoupling and thermal conductive material) to derive an appropriate frequency of “extremely unlikely” (≤ 0.0001 to 0.000001 per year) and uses the midpoint (0.00001) to calculate risk. This frequency includes the entire scenario, not just the initiating event, through vaporization of materials and release to the public from the building.

DBA-3 represents a full-facility fire at the ACRR. The bounding fire scenario evaluated in the DSA was a fire in the facility that was assumed to impact radioactive materials, resulting in a release of those materials. This accident was assumed to involve experiment packages containing radioactive material and irradiated experiments that are temporarily stored in rooms adjacent to the high bay. This accident could occur at any time, including during maintenance or preparation for operations. The potential consequences of this event are equivalent to those that would be expected from an aircraft crash into the ACRR (SNL 2024).

A room fire is normally started by a small, incipient, localized fire that grows into a larger room fire through one of two methods: (1) flashover due to adequate fuel from the initial source or (2) ignition of adjacent flammable materials and fire growth, eventually leading to room flashover. Flashover was a worst-case (unmitigated) scenario in which no intervention (automatic or operator response) was assumed to control or extinguish the fire. The DSA assigned an unmitigated frequency of “anticipated” (≥ 0.01 per year). This SWEIS applies a mitigated frequency of “unlikely” (≤ 0.01 to 0.0001 per year) and uses the midpoint (0.001) to calculate risk. If the transient and fixed combustible loading factors (mass, maximum fire footprint size, and separation between flammables and radioactive material) are actively managed as an element of a comprehensive Fire Protection Program, a fire that initiates in a room is much less likely to lead to a large, fully developed room fire. With the exception of vehicle fires (e.g., forklifts) within a small room, management of the fuel loadings is expected to prevent the occurrence of a fully developed room fire. Normally, 2-hour fire walls, doors, and penetrations are adequate to contain the spread of a fire to adjacent rooms or areas.

The fire was assumed to impact all stored irradiated material and staged radioactive waste. Assuming combustible loading in excess of the amount required for flashover, the MAR contained in both low bay rooms could be impacted by the fire event. MAR in the rooms would be dominated by the activation products contained in the stored, irradiated experiments. The potential source term assumes the facility limit of 20.6 kg of Pu-239 equivalent. The facility limit of 500 Ci of tritium gas was also assumed to be in the facility. The tritium gas was assumed to be in the low bay during the fire, resulting in release of the tritium as water vapor.

In addition, some explosives experiments contain limited amounts of radioactive material. The limit on radioactive materials mixed with or contiguous to explosives is 1 gram of Pu-239 equivalent. The DSA also assumes that the experiment is in the vicinity of the fire. Hence, 1 gram of Pu-239 equivalent intimately mixed with or contiguous to explosives would be dispersed in a vapor form in an inadvertent or uncontained explosion and would yield a release of 1 gram of Pu-239 equivalent.

Due to the reactor’s power history, reactor fuel and fission products were not considered to be impacted by the facility fire. All of the irradiated fuel is stored in either the ACRR pool or the storage pool, which would provide adequate protection from the fire. A limited number of unirradiated fuel elements may be in storage in the high bay; however, the uranium contribution to offsite dose would be insignificant compared to the dose from plutonium.

Sandia Pulsed Reactor Facility

The SPR Facility is also an HC-2 facility located in TA-V. The SPR Facility DSA (SNL 2022b) identifies the provisional facility inventory limits of 14 kg of Pu-239 equivalent. It also analyzes a normal operating limit of 2.61 kg of Pu-239 equivalent. The DSA analyzes three DBAs, of which this SWEIS presents two. DBA-4 represents a facility fire, and DBA-5 reflects the potential consequences of excessive reactivity on a critical experiment.

DBA-4 represents the potential consequences of a full-facility fire, as well as those that could be expected from a seismic event or aircraft crash followed by a fire. The accident assumes that the entire facility MAR (14 kg Pu-239 equivalent) undergoes combustion during storage or processing. Moreover, the facility MAR conservatively subsumes a hypothetical 20 percent enriched UO₂ fuel inventory of 2,000 kg. The radiological hazard associated with 2,000 kg UO₂ fuel is negligible when compared to 14 kg of Pu-239 equivalent facility MAR (SNL 2022b).

DBA-4 could be caused by human error and/or equipment failure (e.g., electrical shorts, overheating of equipment, hot work equipment). The facility fire is primarily a threat during storage and processing activities. A facility fire is not a significant radiological threat to the public during criticality experiment operations.

The ventilation system could also be damaged in an intense fire; however, it is not typically running during storage or processing activities. The DSA assumes the ventilation system does not mitigate the dose consequences of the accident. The robust construction (all concrete with metal doors) of the reactor building, reactor maintenance building, storage vaults, and the underground storage vaults provides substantial fire protection.

This SWEIS evaluates the potential consequences of a facility fire. The SPR facility DSA established an unmitigated frequency of this event as “anticipated” (≥ 0.01 per year) and finds that the mitigated frequency, which takes into account the fire protection program and includes combustible materials controls, would be “extremely unlikely” (≤ 0.0001 to 0.000001 per year) (SNL 2022b). This SWEIS uses the midpoint (0.00001) to calculate risk.

DBA-5 evaluates an accident scenario that results in the release of radionuclides and fission products caused by unplanned or excessive reactivity. The accident would be initiated via an uncontrolled addition of reactivity into the critical assembly. There are several potential causes for the event including, but not limited to, human error, misloading of fuel, misalignment of the fuel, or uncontrolled control rod withdrawal. The accident is assumed to result in failure of fuel cladding with partial fuel vaporization/melt and the associated release of radionuclides and fission products.

The SPR facility DSA estimates that the event would result in the release of fission products associated with 1×10^{18} fissions in a single burst. The DSA establishes an unmitigated frequency of this event as “anticipated” (≥ 0.01 per year) (SNL 2022b). Application of administrative and engineering controls would decrease the potential frequency to no higher than “unlikely” (≤ 0.01 to 0.0001 per year), and this SWEIS uses the midpoint (0.001) to calculate risk.

Auxiliary Hot Cell Facility and Auxiliary Hot Cell Unit

The AHCF encompasses the entire high bay, mid bay, and low bay of Building 6597 and is used primarily to characterize and repackage HC-3 quantities of legacy materials and radioactive waste that accumulated at SNL/NM during the past years of SNL/NM operations supporting various programs. The RCRA-permitted AHCU consists of mixed waste management storage and treatment operations in the high bay of Building 6597.

The *Basis for Interim Operation (BIO) for the Auxiliary Hot Cell Facility (AHCF)* (BIO) (SNL 2022c) addresses management of radioactive materials within the AHCF/AHCU. Planned work activities involving greater than HC-3 TQs of materials are expected to continue until they are finished. After completing HC-3 operations, NNSA plans to return the AHCF and AHCU to categorization as a below HC-3 facility (where radiological inventories would be maintained at less than HC-3 TQs).

The activities that occur at the AHCU include characterization, container handling, staging, material sorting, repacking, and Type B container loading/unloading. The types of materials that are managed at the AHCF/AHCU include:

- hardware from reactor experiments;
- uranium and plutonium fines from reactor failure experiments;
- irradiated and unirradiated TRU waste;
- neutron sources; and
- irradiated and unirradiated fissionable material in the form of pellets, foils, and intact fuel rods or fuel pins.

Most packages contain items with irradiated uranium-235 or Pu-239. Packages stored/staged in the SPR facility dense pack (a storage yard of silos at the SPR Facility) contain decayed fission products from irradiated fuels in either pellet or granular form. The remaining dominant radioactive elements are strontium-90 and cesium-137, which emit beta particles and gamma rays. Some of the other packages that might be managed at the AHCF/AHCU contain actinides (e.g., Pu-238, -239, -240, -241, and -242, americium-241).

A two-stage HEPA filter bank is the primary filter for airflow coming from both the hot cell and a fume hood. The two-stage HEPA filter bank has pre-filters, isolation dampers, and bag in/out capability.

The results of the hazard identification in the BIO (SNL 2022c) indicate that the principal hazards associated with the AHCF/AHCU result from the presence of radioactive materials and wastes. The type and quantity of materials that could be located in the AHCF/AHCU are primarily low-level radioactive waste, TRU waste, and mixed low-level waste that are inappropriate for processing at the RMWMU due to either their form or quantity. The AHCU is the only RCRA-permitted operating waste management facility in TA-V. This material either exceeds HC-3 TQs for radioactive material or presents an external exposure hazard due to penetrating ionizing radiation. An administrative control limits the total quantity of radioactive

materials at the AHCF to less than 80 percent of the HC-2 TQs. The current HC-2 TQ for Pu-239 equivalent is 2.61 kg, which is used in the BIO and in this SWEIS. As identified in Section D.3.3, TQs could change if SNL/NM were to implement DOE-STD-1027-2018 (DOE 2019b) or a newly updated DOE-STD-1027, after approval. As a point of reference, the HC-2 TQ for Pu-239 equivalent under DOE-STD-1027-2018 is 1.09 kg, a 58 percent reduction from its current TQ under the NNSA 1027 Supplemental Guidance (NNSA 2011).

In the existing inventory, hazardous chemicals are limited to trace hazardous constituents and toxic metal components of solid metal parts. Hazardous chemicals are expected to be minimal at the AHCF/AHCU and to occur primarily as minor constituents of the legacy material to be processed. The potential for deflagration inside the hot cell or within the high bay or mid bay, resulting in a release of radiological material, is considered in the BIO HA, as are loading and unloading of radioactive material containers at the AHCF/AHCU.

Based on review of the current AHCF/AHCU BIO, this SWEIS selected DBA-6 to represent an accident involving an impact and breach of radioactive material container(s) and an ensuing facility fire.

DBA-6 is a maximum reasonably foreseeable accident involving the AHCU and assumes release of the maximum TQs of Pu-239 equivalent (2.61 kg). The event is assumed to be initiated by an incipient fire spreading to radioactive materials in containers, fume hood, hot cell, or shield wall, or by a radioactive material container being impacted by a forklift, vehicle, crane drop, or other means while being handled, staged, or processed, with an ensuing fire that spreads and impacts radioactive materials in other containers and throughout the facility. This DBA includes the fire's thermal influence on containers of radioactive material becoming highly pressurized and ultimately breaching or off-gassing.

D.3.5.2 Modernized Operations Alternative Radiological Accident Scenarios

As discussed in Section D.3.3, the Modernized Operations Alternative continues existing programs and activities by modernizing facilities, as necessary. This alternative would not expand capabilities and operations beyond those that currently exist. Radiological accident impacts of the replacement and upgraded facilities are bounded by the accidents analyzed in this SWEIS since the amount of radioactive material available for an accident would be unchanged. New systems/equipment and facilities would consist of in-kind replacements of removed legacy systems/equipment and facilities (i.e., NGE+, replacement of HERMES and Saturn accelerators). Their current processes and capabilities would not change with the Modernized Operations Alternative. The new facilities would be less than HC-3 radiological facilities, would replace the existing capabilities at SNL/NM currently being performed in older buildings, and would not pose any additional radiological hazard to the public as defined by DOE-STD-1027 (DOE 1997). Operations in the AHCU, including any recladding efforts, would stay below HC-2 TQs to ensure the continued safety of workers and the public.

As for the potential change in the hazard classification standard DOE-STD-1027, SNL/NM facilities are currently compliant with DOE-STD-1027-1992 (DOE 1997), as supplemented by NNSA 1027 Supplemental Guidance (NNSA 2011). SNL/NM facilities could begin operations under DOE-STD-1027-2018 (DOE 2019b) or another yet-to-be-issued standard within the period

analyzed in this SWEIS. The majority of the radiological facilities (<HC-3) and HC-3 facilities at SNL/NM manage their operations in accordance with the “sum of ratios” for the TQs from NNSA 1027 Supplemental Guidance (NNSA 2011) to ensure that each facility stays within its established categorization.¹⁵ The primary nuclides controlled at these facilities include plutonium and tritium. Table D-18 provides a perspective on how the threshold values of these radionuclides could change between NNSA 1027 Supplemental Guidance (NNSA 2011) and DOE-STD-1027-2018 (DOE 2019b).

As shown in the table, the TQs for tritium (for either HC-2 or HC-3 thresholds) would not change. The HC-2 TQs for plutonium would decrease by 58 percent from the values in NNSA 1027 Supplemental Guidance, which would result in smaller quantities of the material that could be handled and stored in an HC-3 facility at any one time without changing the facility’s hazard classification.

For facilities that are currently below HC-3 (e.g., GIF, Ion Beam Laboratory, HERMES-III), operations would maintain the sum of ratios below 1 as compared to the HC-3 threshold, which for these primary radionuclides did not change appreciably. Similarly, operations at the AHCF/AHCU, SNL/NM’s only HC-3 facility, would continue to maintain the sum of fractions below 1 as compared to the HC-2 threshold. NNSA does not expect to increase the hazard classification of the AHCF/AHCU.

Another factor that would contribute to the determination that doses to the co-located worker and the public would be unlikely to increase as a result of the evolution of DOE-STD-1027 is the underlying basis for the selection of the TQs. This basis remains unchanged from the 1992 version (DOE 1997) through to the 2018 version (DOE 2019b). The HC-3 TQ values represent the quantity of a radioactive material that, if released, would result in an unmitigated dose consequence of 10 rem to a hypothetical individual at 30 meters away from the release. Similarly, the HC-2 TQ values represent the quantity of a radioactive material that, if released, would result in a dose consequence of 1 rem at just less than 300 meters. Even though particular TQs have changed between versions of the standard (some have increased, some have decreased), the relationship of potential dose consequence relative to distance has remained essentially constant.

Based on the discussion in this section, the accidents presented in Section D.3.5.1 are also representative of potential accidents that could occur under the Modernized Operations Alternative.

¹⁵ To maintain the radioactive element inventory below the HC-3 threshold, the sum of the ratios of the quantity of each radioactive element relative to its HC-3 threshold limit must be less than 1. Similarly, for HC-2 facilities, the sum of ratios of the quantity of each radioactive element relative to its HC-2 threshold limit must be less than 1. In practice, SNL/NM facilities maintain the sum of ratios significantly below the threshold to prevent inadvertently exceeding that threshold.

Table D-18. Comparison of TQs of Select Radionuclides for NNSA 1027 Supplemental Guidance and DOE-STD-1027-2018

Radionuclide	NNSA 1027 Supplemental Guidance (NNSA 2011)				DOE-STD-1027-2018 (DOE 2019b)				Percent Increase (Decrease)	
	HC-3		HC-2		HC-3		HC-2		HC-3	HC-2
	TQ (Ci)	TQ (grams)	TQ (Ci)	TQ (grams)	TQ (Ci)	TQ (grams)	TQ (Ci)	TQ (grams)		
Tritium (H-3)	16,000	1.6	300,000	30	16,000	1.6	300,000	30	0%	0%
Pu-239	2.4	38.6	162	2,610	2.38	38.2	67.6	1,090	(<1%)	(58%)

Source: NNSA (2011) and DOE (2019c).

The estimated unmitigated frequency of DBA-6 is “anticipated” (≥ 0.01 per year) (SNL 2022c). Application of administrative and engineering controls (e.g., fire protection systems) would decrease the potential frequency to no higher than “unlikely” (≤ 0.01 to 0.0001 per year), and this SWEIS uses the midpoint (0.001) to calculate risk.

D.3.5.3 Radiological Accident Scenarios under the Expanded Operations Alternative

Section D.3.4 discusses the projects proposed under the Expanded Operations Alternative. This alternative includes the actions in the Modernized Operations Alternative plus actions that would expand operations and missions to respond to future national security challenges and meet increasing requirements beyond the current capabilities at SNL/NM.

The only project proposed under the Expanded Operations Alternative that warrants additional discussion in this section is the proposed CREST Complex. As identified in Section D.3.4, the CREST Complex would include the CREST nuclear facility, which would be an HC-2 facility located in TA-V. The *Pre-Conceptual Hazards Analysis* (SNL 2018b) expects that the CREST nuclear facility would operate under many of the same limits identified in Section D.3.5.1 for the ACRR. For example, the MAR limits for experiments (in grams Pu-239 equivalent) are assumed to remain consistent with those presently deployed at the ACRR. The ACRR accident DBA-2 evaluated in Section D.3.5.1 used the higher ACRR provisional experiment MAR limit from the 1999 Safety Analysis Report and SNL/NM SWEIS for evaluation of potential consequences of an experiment accident (SNL 1999 and DOE 1999). Additionally, the provisional facility limit of the CREST nuclear facility would be 20.6 kg of Pu-239 equivalent (same as at the ACRR), but the normal operations limit would be increased from 2 kg to 2.61 kg. The ACRR accident DBA-3 evaluated in Section D.3.5.1 conservatively used the 20.6 kg facility limit.

According to the *Pre-Conceptual Hazards Analysis* (SNL 2018b), the proposed CREST design would include safety systems that add to or surpass those included in the ACRR design. The differences between the potential consequences from accidents associated with the ACRR and the CREST nuclear facility will continue to be evaluated and refined as part of CREST’s ongoing safety-basis assessment process, which would ultimately be presented in the facility’s final DSA. Therefore, it stands to reason that the potential accidents and mitigated consequences associated with the CREST nuclear facility would be expected to be no greater than those estimated for the ACRR. The CREST nuclear facility would have a DSA completed after the detailed design is done to verify the safety basis for the facility prior to operations. This would be in compliance with DOE-STD-1189-2016 (DOE 2016a) and DOE-STD-1237-2021 (DOE 2021c).

NNSA anticipates the possibility that under the Expanded Operations Alternative, the ACRR and the CREST nuclear facility could be operating concurrently for a limited time. There would be challenges to this scenario because the CREST facility would likely need to use some or all of the UO₂-BeO fuel from the ACRR and/or newly purchased/procured UO₂-BeO fuel for its intended operations, and also use existing or new Training, Research, Isotopes, General Atomics (TRIGA) fuel for other potential critical and subcritical cores deployed in CREST. For conservative analytical purposes, this SWEIS assumes that both facilities operate concurrently for about 10 years.

If these facilities operate concurrently, the total number of tests performed annually could be more than three times the number currently performed under the No-Action Alternative at ACRR. Because the frequency ranges evaluated in this SWEIS are in bands of 100 years (e.g., the frequency bin “unlikely” equates to ≤ 0.01 to 0.0001 per year), a change on the order of three times would not likely change the frequency bin of the accident and therefore not result in a significant additional risk.

The key difference in potential accident risk from both facilities operating concurrently would be associated with an event that could affect both facilities. This would occur only in a potential natural phenomena hazard event that affects all of TA-V, such as an earthquake, flood, or high winds, as well as possibly in the case of a wide-reaching external event such as a large-scale aircraft crash or significant wildland fire. In line with such assumptions, the potential site-wide seismic event (followed by a fire) analyzed in Section D.3.10 assumes that the CREST nuclear facility would result in potential offsite consequences to the same extent as previously analyzed for the ACRR.

Other than the addition to the potential seismic risks, no potential accident impacts associated with the projects under the Expanded Operations Alternative would be larger than the accident risks presented for the No-Action Alternative. All of the potential radiological accident scenarios associated with the projects proposed under the Expanded Operations Alternative would be bounded by radiological accident scenarios presented in Section D.3.5.1 for the No-Action Alternative.

D.3.5.4 Consequences of Potential Radioactive Material Release Accidents

The preceding sections describe the radiological accidents analyzed in this SWEIS for each accident identified for the No-Action, Modernized Operations, and Expanded Operations Alternatives.

The SNL/NM safety-basis documents use the ICRP Publications 71 and 72 dose conversion factors (ICRP 1995a and ICRP 1995b) for public dose calculations, ICRP-68 (ICRP 1994b) dose conversion factors for co-located worker dose, and ICRP-66 (ICRP 1994a) for breathing rate used in the dose calculations. Hence, for this SWEIS, NNSA used the dose coefficients and breathing rate from these ICRP publications for calculating the accident scenario consequences, which would provide consistency with the safety-basis documents for those facilities. Table D-19 and Table D-20 present the radiological accident frequency and calculated consequences under conservative and average meteorological conditions, respectively. As discussed in Section D.3.1, the distance to the MOI is assumed to be 1,350 meters and is representative of the exclusion area boundary in TA-V. Table D-16 shows the population within a 50-mile radius of SNL/NM.

Consistent with DOE NEPA accident analysis recommendations (DOE 2002), the consequences presented in Table D-19 and Table D-20 represent the range of reasonably foreseeable accidents, including low-probability/high-consequence accidents and high-probability/low-consequence accidents. Also, because “risk” is a combination (i.e., multiplicative product) of the accident’s probability (or frequency) and consequence, the accidents with the highest doses in Table D-19

and Table D-20 do not necessarily dominate SNL/NM’s radiological accident risk, as the following discussion describes.

The DBA descriptions and source terms reported in the referenced SNL/NM facility DSAs are based on unmitigated scenarios. Each of the facilities has been designed and would be operated to reduce the likelihood of these accidents to the extent practicable. Design features and operating practices would also limit the extent of any accidents and mitigate the consequences for the workers, public, and environment if they occurred. As with all SNL/NM facilities, the safety controls are expected to be sufficient, such that the likelihood of any of these accidents occurring would be at least one frequency bin lower than the unmitigated frequency identified in the facility DSA (e.g., an unmitigated scenario with an “unlikely” frequency would be expected to have a mitigated frequency of no more than “extremely unlikely”). This approach has been applied consistently across all DBAs in this SWEIS.

The LCFs identified in Table D-19 and Table D-20 are “conditional” risks, based on the assumption that the accident has occurred with the assumed meteorological conditions. Table D-21 shows the total fatality risk for each analyzed accident and the meteorological conditions (as described in Section D.3.1.4).

As shown in Table D-21, the maximum offsite population risk (with conservative meteorology) from an ACRR facility fire (DBA-3) is estimated to be 0.00257 LCF per year, or less than one cancer fatality every 390 years. To put this risk in perspective, in 2022, the total annual death rate from all cancers in New Mexico was 177.1 per 100,000 people (CDC 2024). Within the 50-mile radius of SNL/NM (1,075,720 people), this would equate to over 1,900 deaths within the same population (not related to SNL/NM).

Table D-21 shows that a potential ACRR facility fire (DBA-3) would contribute about 88 percent to the total offsite population risk when compared to all the accident risks listed.

**Table D-19. Radiological Accident Frequency and Consequences under the No-Action Alternative –
Conservative Meteorology**

Accident Scenario	Frequency (per year)	MOI ^{a, b}		Offsite Population ^c		Co-Located Worker ^{a, d}	
		Dose (rem)	LCFs ^e	Dose (person-rem)	LCFs ^e	Dose (rem)	LCFs ^e
DBA-1: ACRR, TA-V: Control rod bank inadvertent withdrawal ^f	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	3.0	1.80×10^{-3}	6,570	3.94	19	1.14×10^{-2}
DBA-2: ACRR, TA-V: Pulse/TRW experiment malfunction	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	2.4	1.44×10^{-3}	8,370	5.01	51.6	3.09×10^{-2}
DBA-3: ACRR, TA-V: Facility fire	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	1.33	7.98×10^{-4}	4,280	2.57	26	1.56×10^{-2}
DBA-4: SPR, TA-V: Full-facility fire during critical experiment	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	1.2	7.20×10^{-4}	2,230	1.34	7.8	4.68×10^{-3}
DBA-5: SPR, TA-V: Excessive reactivity during critical experiment	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	0.0035	2.10×10^{-6}	3.77	2.26×10^{-3}	0.35	2.10×10^{-4}
DBA-6: AHCU, TA-V: Facility fire	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	0.14	8.40×10^{-5}	450	0.27	0.11	6.6×10^{-5}

- The MOI and the co-located worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person, and the fatalities would be multiplied by the number of persons exposed.
- The MOI is assumed to be located at the exclusion area boundary, 1,350 meters from the accident, regardless of the sector.
- Based on Table D-16.
- A co-located worker is assumed to be at a distance of 100 meters from the facility.
- Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). Scientific notation is used to simplify the presentation; as a clarifying example, 1.80×10^{-3} is the same as 0.0018, or one chance of an LCF in 556 years.
- These consequences are for an unmitigated accident. Mitigation measures and controls would not result in fuel melt or cladding damage, and there would be no release or consequences.

**Table D-20. Radiological Accident Frequency and Consequences under the No-Action Alternative –
Average Meteorology**

Accident Scenario	Frequency (per year)	MOI ^{a, b}		Offsite Population ^c		Co-Located Worker ^{a, d}	
		Dose (rem)	LCFs ^e	Dose (Person-rem)	LCFs ^e	Dose (rem)	LCFs ^e
DBA-1: ACRR, TA-V: Control rod bank inadvertent withdrawal ^f	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	0.21	1.26×10^{-4}	535	0.32	2.44	1.46×10^{-3}
DBA-2: ACRR, TA-V: Pulse/TRW experiment malfunction	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	1.28×10^{-1}	7.71×10^{-5}	504	0.30	1.77	1.06×10^{-3}
DBA-3: ACRR, TA-V: Facility fire	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	6.41×10^{-2}	3.85×10^{-5}	257	0.15	1.81	1.09×10^{-3}
DBA-4: SPR, TA-V: Full-facility fire during critical experiment	$\leq 1 \times 10^{-4}$ to 1×10^{-6} (extremely unlikely)	3.65×10^{-2}	2.19×10^{-5}	147	8.82×10^{-2}	1.03	6.18×10^{-4}
DBA-5: SPR, TA-V: Excessive reactivity during critical experiment	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	4.17×10^{-4}	2.50×10^{-7}	4.12×10^{-1}	2.47×10^{-4}	1.55×10^{-1}	9.30×10^{-5}
DBA-6: AHCF/AHCU, TA-V: Facility fire	$\leq 1 \times 10^{-2}$ to 1×10^{-4} (unlikely)	6.76×10^{-3}	4.06×10^{-6}	27.3	1.64×10^{-2}	0.19	1.14×10^{-4}

- The MOI and the co-located worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person, and the fatalities would be multiplied by the number of persons exposed.
- The MOI is assumed to be located at the exclusion area boundary, 1,350 meters from the accident. The MOI dose is the average of all 16 sectors.
- Based on Table D-16.
- A co-located worker is assumed to be at a distance of 100 meters from the facility.
- Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). Scientific notation is used to simplify the presentation; as a clarifying example, 1.26×10^{-4} is the same as 0.000126, or one chance of an LCF in 7,937 years.
- These consequences are for an unmitigated accident. Mitigation measures and controls would not result in fuel melt or cladding damage, and consequences would be significantly lower.

Table D-21. Radiological Accident Fatality Annual Risk under the No-Action Alternative

Accident Scenario	Conservative Meteorology			Average Meteorology		
	MOI (LCF ^a)	Offsite Population ^{b, c} (LCF ^a)	Co-Located Worker ^c (LCF ^a)	MOI (LCF ^a)	Offsite Population ^b (LCF ^a)	Co-Located Worker ^c (LCF ^a)
DBA-1: ACRR, TA-V: Control rod bank inadvertent withdrawal	1.80×10^{-8}	3.94×10^{-5}	1.14×10^{-7}	1.26×10^{-9}	3.20×10^{-6}	1.46×10^{-8}
DBA-2: ACRR, TA-V: Pulse/TRW experiment malfunction	1.44×10^{-8}	5.01×10^{-5}	3.09×10^{-7}	7.71×10^{-10}	3.00×10^{-6}	1.06×10^{-8}
DBA-3: ACRR, TA-V: Facility fire	7.98×10^{-7}	2.57×10^{-3}	1.56×10^{-5}	3.85×10^{-8}	1.50×10^{-4}	1.09×10^{-6}
DBA-4: SPR, TA-V: Full-facility fire during critical experiment	7.20×10^{-9}	1.34×10^{-5}	4.68×10^{-8}	2.19×10^{-10}	8.81×10^{-7}	6.18×10^{-9}
DBA-5: SPR, TA-V: Excessive reactivity during critical experiment	2.10×10^{-9}	2.26×10^{-6}	2.10×10^{-7}	2.50×10^{-10}	2.47×10^{-7}	9.30×10^{-8}
DBA-6: AHCF/AHCU, TA-V: Facility fire	8.40×10^{-8}	2.70×10^{-4}	6.60×10^{-8}	4.06×10^{-9}	1.64×10^{-5}	1.14×10^{-7}

- a. Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). Scientific notation is used to simplify the presentation; as a clarifying example, 1.80×10^{-8} is the same as 0.000000018, or one chance of an LCF in 55.6 million years.
- b. Based on Table D-16.
- c. A co-located worker is assumed to be at a distance of 100 meters from the facility.

D.3.6 Accident Scenarios Involving Toxic Chemicals

The evaluation of potential accidents involving toxic chemicals uses protective action criteria (PAC) to quantify the significance of an accident for both co-located workers and the public, as recommended by DOE Order 151.1E (DOE 2024) and DOE-STD-3009 (DOE 2014).

Section D.3.1.5 addresses potential impacts to involved workers. The three levels of PAC are:

- PAC-1** The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, non-sensory effects. However, these effects are not disabling and are transient and reversible upon cessation of exposure.
- PAC-2** The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape.
- PAC-3** The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening adverse health effects or death.

For toxic chemical hazards, PAC values are based on the following hierarchy of exposure limit values:

- If available, use 60-minute Acute Exposure Guideline Levels (AEGLs) published by the EPA.
- If AEGLs are not available, use Emergency Response Planning Guideline (ERPG) values produced by the American Industrial Hygiene Association.
- If neither AEGLs or ERPGs are available, use Temporary Emergency Exposure Limit values developed by DOE's Subcommittee on Consequence Assessment and Protective Actions.

As identified in Section D.3.1, the largest user of hazardous chemicals at SNL/NM is the MESA Complex, and potential consequences of an accident associated with this facility are presented in this section. Operations in the MESA Complex involve research, development, and production of radiation-hardened microsystems for national security needs. The SiFab is a production facility for integrated microsystems. The MicroFab provides engineering and research capabilities for microelectronics research. Both the MicroFab and SiFab are classified as moderate-hazard industrial facilities based on primary hazard screening determinations that identify the potential for an accidental release of hazardous materials, specifically, toxic and/or highly toxic gases (this SWEIS refers to them collectively as toxic gases) with the potential to significantly impact co-located (onsite) workers and members of the offsite public.

The evaluation of safety implications at the MESA Complex involves the consideration of several related SNL/NM documents:

- *Hazardous Chemical Inventory Guidelines, Purpose, and Process*, Appendix C, “Final Chemical List and Threshold Quantities” (SNL 2021b);
- *[SiFab and MicroFab] Chemical Release Modeling Evaluation* (SNL 2019c);
- *Microsystems Fabrication Facility and Silicon Fabrication Facility Safety Assessment* (SNL 2023d); and
- *[MESA] Complex Emergency Planning Hazards Assessment* (SNL 2021d).

The “Final Chemical List and Threshold Quantities” (SNL 2021b; Appendix C) identifies TQs for hazardous chemicals that, if released in an uncontrolled manner, could result in concentrations at 100 meters that could exceed PAC-2 values. If a building contains more than these TQs, SNL/NM then prepares additional analyses based on the actual type, form, and quantity of the chemicals stored and the specific location and storage method.

Because the MESA Complex stores and uses quantities of hazardous chemicals and toxic gases that exceed values in the “Final Chemical List and Threshold Quantities,” the *SiFab and MicroFab Chemical Release Modeling Evaluation* (SNL 2019c) modeled the worst-case scenario of potential chemical releases from the loading dock area of the MESA Complex: the MicroFab, the SiFab, and the specialty gas facility. The modeling (SNL 2019c) supports the analysis in the facility’s safety assessment (SNL 2023d). The analysis addresses the potential catastrophic release of the single largest toxic chemical container based on the current inventory. Table D-22 lists the hazardous chemicals and gases that were modeled to determine potential consequences (SNL 2019b). Table D-22 also includes the PAC values for each chemical, the primary hazard, the current (as of July 2019) inventory of that chemical in the MESA Complex, and the TQ for each chemical from the “Final Chemical List and Threshold Quantities” (SNL 2021b; Appendix C). The PAC values are developed in units of either parts per million (ppm) or milligrams per cubic meter (mg/m³). In Table D-22, the PAC are listed in the units provided in the PAC dataset (DOE 2023d), which are primarily presented as ppm.

The initial screening analysis of the MESA Complex included a worst-case release scenario and assumed an outdoor release of the entire contents of a full container or cylinder over a 15-minute period (unmitigated release) (SNL 2019c). Therefore, no credit for control was taken for building confinement. The initial screening was modeled to a toxic endpoint (PAC-3) to determine the maximum distance from the facility that could theoretically experience potential life-threatening effects in the event of an uncontrolled outdoor release. Additional modeling was then completed to identify the potential exposure distances against PAC-2 values.

Table D-22. MESA Complex Hazardous Chemical Inventory and PAC

Chemical	PAC-1 ^a (ppm)	PAC-2 ^a (ppm)	PAC-3 ^a (ppm)	TQ (pounds)	Inventory (pounds)	Hazard
Ammonia	30	160	1,100	4.05	50	Flammable, toxic, corrosive to tissues
Arsine	0.015	0.17	0.5	0.026	40	Flammable, pyrophoric, toxic, corrosive to tissues
Boron trichloride	0.19	2.1	71	0.525	10	Toxic
Boron trifluoride	2.5	29	88	1.59	0.73	Toxic
Carbon monoxide	75	83	330	3.45	14.72	Asphyxiant
Chlorine	0.5	2	20	0.3	15	Toxic, oxidizer, burns eyes and skin
Dichlorosilane	0.9	11	50	3	50	Toxic, corrosive to tissues, flammable, pyrophoric, water reactive
Fluorine	1.7	5	13	0.375	0.33	Toxic, corrosive to tissues, oxidizer
Germane	0.015	0.17	0.5	0.0255	22.35	Toxic, corrosive to tissues, flammable, pyrophoric, water reactive
Hydrochloric acid	1.8	22	100	15	Note b	Corrosive to tissues
Hydrofluoric acid	1.0	24	44	2.5	Note b	Corrosive to tissues
Hydrogen bromide	1.0	40	120	12	30	Toxic, corrosive to tissues
Hydrogen chloride	1.8	22	100	60	60	Corrosive to tissues
Hydrogen fluoride	1.0	24	44	-	8.4	Corrosive to tissues
Nitric oxide	0.16	24	20	0.675	4.68	Toxic, corrosive to tissues, oxidizer
Nitrogen trifluoride	200	530	860	225	44	Toxic, oxidizer
Nitrous oxide	910	10,000	20,000	2,745	66	Central nervous system depressant, oxidizer, corrosive to tissues
Phosphine	1.0	2.0	3.6	0.129	27	Flammable, pyrophoric, toxic, corrosive to tissues
Silane	100	130	270	9.3	26.46	Flammable, pyrophoric, toxic
Sulfur hexafluoride	3,000	33,000	200,000	7,200	100	Asphyxiant
Tungsten hexafluoride	4.9 (mg/m ³)	24 (mg/m ³)	320 (mg/m ³)	1.905	22	Toxic, corrosive to tissues, oxidizer

a. PAC values from PAC database search at <https://edms3.energy.gov/pac/Search>.

b. These acids are in liquid form and do not have separate inventory controls.

Due to the density of buildings and activity in the MESA Complex area, the nearest distance to public access was determined to be 20th Street, which is about 200 meters from the release point of the gas shipping and receiving area in the MESA Complex. Several areas within this 200-meter radius are normally used by co-located workers and members of the public. This includes roads, parking lots, and buildings not associated with the MESA Complex; however, the

nearest truly public access point is 20th Street (SNL 2019c). Figure D-2 shows the area reviewed in this analysis; the 200-meter boundary is displayed with 50-meter radius intervals for reference.



Source: SNL 2019c.

Figure D-2. A 200-Meter Radius Area of Toxic Gas Release for the MESA Complex

The modeling results provided an estimated distance to the selected PAC endpoint, with the assumption of a single wind direction. The modeled impact zone encompasses an area much larger than would be impacted by the gas plume or cloud during an actual release. During an actual release, the plume would follow the wind direction to produce a smaller footprint of impact because the plume is generally oriented along an axis in one direction.

The initial coarse modeling showed that, under the uncontrolled, bounding release scenario, six toxic chemicals of concern could exceed the PAC-3 values at distances beyond 200 meters. The six toxic chemicals of concern include arsine, germane, phosphine, hydrogen chloride, hydrogen fluoride, and nitric oxide (SNL 2019c). Additional modeling was conducted to determine the effectiveness of mitigating factors for release conditions, including engineered controls and physical chemical behavior.

Three of the toxic chemicals – arsine, germane, and phosphine – are received from the vendor and stored in cylinders with restrictive flow orifice (RFO) valves in place. RFOs are used to limit the potential danger of an uncontrolled flow from a compressed gas cylinder. They are designed to thread into the outlet of the cylinder, and they have no moving parts. The flow rate through an RFO is a function of pressure, temperature, orifice size, and specific gravity of the gas inside the cylinder. After refining the model to account for the lower flow rate from the RFO, the PAC-3 distances from a postulated release were calculated to be less than 200 meters for all three gases, indicating that, with passive engineering controls in place, significant offsite consequences would not be expected.

The more refined modeling also evaluated the potential release scenario of evaporation of liquid acids, hydrochloric acid (which evaporates to hydrogen chloride), and hydrofluoric acid (which evaporates to hydrogen fluoride). This more refined model demonstrated that evaporation of accidental spills of these liquids may result in localized consequences to workers; however, the maximum PAC-3 consequence level would be limited to a radial distance of 4–10 meters from the release (SNL 2019c).

The *Microsystems Fabrication Facility and Silicon Fabrication Facility Safety Assessment* (SNL 2023d) uses the results of the modeling evaluation (SNL 2019c) to evaluate all potential hazards associated with operations of the MESA Complex. The hazards assessment includes a qualitative risk assessment that examines the initial conditions and controls necessary to ensure that operations continue to minimize potential safety risks to workers (involved and co-located) and the offsite public. Examples of these initial conditions and controls include:

- A just-in-time ordering and delivery system is used to order toxic gas cylinders when existing cylinders are almost empty; as mentioned previously in this section, some toxic gases are delivered with an RFO in place.
- The inventory control process ensures that the quantity of toxic gases does not exceed the OSHA process safety management and the American Industrial Hygiene Association ERPG level 3 (ERPG-3) thresholds at the public boundary.
- The MicroFab and SiFab are designed to withstand a performance category 2 earthquake and a high wind loading of 93 miles per hour.
- Firewalls and fire protection systems reduce the potential consequences of a fire to neighboring facilities that could lead to a release of hazardous materials.
- The MicroFab and SiFab include lightning protection systems.
- Toxic gas cylinders are stored with seismic restraints, and cylinders are stored and handled with a cylinder cap and a valve cap to prevent accidents involving the valve stem.
- Bollards are placed around the external storage area of the silane pad to prevent vehicle collisions.
- Seismic shutoff valves are in place for hydrogen and natural gas supplies to the MESA Complex.

The hazard evaluation process in the MESA Complex Safety Assessment identified credible event scenarios based on the identified hazards and initial conditions that could influence the assigned consequence and probability numbers. The qualitative risk analysis identified the available controls necessary to prevent and minimize the potential negative impacts to an acceptable level. No scenarios were identified that have the potential to have significant offsite (public) consequences (SNL 2023d).

D.3.7 Accident Scenarios Involving Energetic Materials

Section D.3.1.2 describes the controls used to manage the level of protection and potential risk of accidents involving EM (i.e., explosives). Accidental explosive detonation scenario impacts are short range and typically affect only onsite workers. Section D.3.1.5 discusses involved worker impacts.

EMs are used, handled, and transported to and from a number of SNL/NM facilities to support test activities on the site. Large quantities of explosives are also stored in various types of storage magazines and bunkers within the overall SNL/NM and KAFB properties that are specially designed to store such materials. All of the explosive materials are subject to DOE explosives handling and storage rules. As identified in Section D.3.1.2, ESSPs are prepared for all storage facilities to ensure that quantities of explosives and storage practices comply with administrative and safety requirements. In addition, SNL/NM activities involve the use of pressurized and bottled gases, large quantities of oil, and JP-8 jet fuel, and other fuels and propellants.

SNL/NM is a research, development, test, and evaluation facility. For test activities involving the use of EM and other hazardous materials, extensive work planning and controls and safety assessments are performed to ensure that personnel directly involved in the test and personnel who are unrelated to the test operation are provided the appropriate level of protection based on applicable safety requirements. Hazards from EM testing are evaluated and, depending on test objectives, mitigated using a variety of engineered and administrative controls. SNL/NM uses a combination of regulatory requirements, analytical and modeling tools, empirical data, and physical calculations to define hazard areas for EM test operations. EM hazards and associated controls are unique to each test operation and the associated hazard areas are limited to SNL/NM-controlled areas. The potential for EM hazards to affect receptors outside of the installation is limited to anomalous events, which SNL/NM actively engages in work planning and controls to reduce the probability of occurrence.

For example, test operations involving intentional initiation of a rocket motor rail sled at the RST Complex would be conducted on a test range with an approved ESSP. As an example of engineered control, the test facility may employ flight destabilization features to reduce the probability of sustained motor free flight beyond SNL/NM controlled premises in the unlikely event of an uncontrolled motor free flight. Additionally, SNL/NM maintains a lease agreement with the state of New Mexico for the La Semilla Buffer Zone, which limits development adjacent to the RST Complex, further limiting the potential for impact to offsite receptors. Additional administrative controls, engineering, operations, planning best practices, and facility designs help prevent an accident involving EM and would limit the impacts if an anomalous event were to occur. Planned test operations where the hazard area extended beyond SNL/NM-controlled premises would require advanced coordination with affected stakeholders. If a test article were to

travel outside of SNL/NM-controlled areas, SNL/NM personnel would engage the appropriate parties and recover the item(s) if authorized to do so.

Within portions of SNL/NM, EM used in tests include explosives used in a number of different facilities, including, but not limited to Thunder Range, Site 9940, and the Drop Water Impact Facility. Solid propellants in rocket motors are used at the RST Complex and ACF. Flammable liquids, such as JP-8, are used at the Lurance Canyon Burn Site, and propane and bulk gaseous hydrogen are used in various facilities. Great care is taken in the transport, storage, handling, and use of these flammable and potentially explosive materials that have the potential to injure or kill workers in an accident.

The largest quantities of flammable materials within the more populated portions of the site include propane tank trucks that are occasionally onsite at SNL/NM to provide fuel for tests at the outdoor test facility and hydrogen supplied in U.S. Department of Transportation over-the-road-approved trailer-mounted tube tanks that are transported to the site by vendors; parked in approved, permanent locations while in use; and then replaced by the vendor when needed. The vendor systems have standard industrial safety features, including excess flow control valves that are expected to minimize the potential for large leaks within supplied buildings or to the areas around the tanks, as well as piping that limits the potential for leakage in normal and catastrophic events. Although these flammable materials could fuel large fires, a large air-fuel explosion is not expected.

As with accidental explosives detonation, a potential deflagration of flammable materials would have the potential for direct impacts to personnel (involved and co-located workers), including injuries and death; however, offsite impacts from such an event would not be expected.

D.3.8 Accident Scenarios Involving Biological Hazards

The SNL/NM laboratories have, for decades, performed biological research requiring BSL-1 and BSL-2 safeguards. The facilities are designed for conducting safe and secure research and storage of infectious microorganisms and biologically derived toxins. Operation of these facilities under BSL-1 and BSL-2 requirements and safeguards complies with the guidelines specified in the *Biosafety in Microbiological and Biomedical Laboratories* (BMBL) (CDC 2020) for BSL-1 and BSL-2 containment laboratories and federal regulations governing select agents and toxins (biosecurity). The BMBL is an advisory document developed by the U.S. Department of Health and Human Services, National Institutes of Health, and Centers for Disease Control and Prevention. Biosafety practices are intended to reduce or eliminate exposure of individuals and the environment to potential biological hazards and select agents. Biosecurity practices are also intended to prevent the loss, theft, release, or misuse of biological hazards and research-related information by limiting access to facilities and this information.

Activities related to BSL-1 and BSL-2 materials are normally categorically excluded from further NEPA review in accordance with 10 CFR Part 1021 under B3.12. The specific categorical exclusion states:

Siting, construction, modification, operation, and decommissioning of microbiological and biomedical diagnostic, treatment and research facilities

(excluding Biosafety Level-3 and Biosafety Level-4), in accordance with applicable requirements and best practices including, but not limited to, laboratories, treatment areas, offices, and storage areas, within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible).

As such, operations of BSL-1 and BSL-2 facilities would be unlikely to result in adverse consequences to co-located workers or the offsite public and are not addressed further in this SWEIS.

D.3.9 Accident Scenarios Involving Onsite Transport of Material

Onsite transfers at SNL/NM are defined as the movement of materials between facilities. SNL/NM conducts its packaging and transportation activities for onsite transfers of hazardous materials, including materials of national security interest, according to a Transportation Safety Document (TSD) (SNL 2022h). These activities meet the requirements in DOE Order 460.1D (DOE 2016b) and DOE Order 461.2 (DOE 2010b) for DOE contractors to comply with the hazardous materials regulations (HMRs) in 49 CFR Parts 171–180, or implement a site-specific TSD to meet equivalent safety for deviations from HMRs for non-compliant transfers. Onsite transportation of explosives is performed in accordance with the requirements of DOE-STD-1212-2019 (DOE 2019a) and Chapter 33 of the *ES&H Manual* (SNL 2023f). Compliance with the HMRs addresses potential hazards associated with chemical, explosive, biological, industrial, and radiological materials to ensure safe transport of hazardous materials. SNL/NM occasionally transports quantities of radiological materials onsite that do not conform to the TSD requirements (e.g., greater than HC-3 TQs). In accordance with the TSD (SNL 2022h), these onsite transfers require NNSA/SFO approval and, in the case of radiological materials greater than HC-3 TQs, a transfer-specific DSA. These additional steps ensure that potential offsite consequences of an accident are kept ALARA.

Current and projected operations at SNL/NM do not typically include quantities of radiological materials that exceed HC-3 thresholds identified in NNSA 1027 Supplemental Guidance (NNSA 2011). All applicable requirements of the HMRs (or site-specific equivalent) must be implemented for onsite transfers of radioactive material, except where deviations from the HMRs have been identified and analyzed, and communications and controls have been derived to mitigate the associated risk. In most cases, quantities involved in onsite shipments would be less than HC-3 TQs.

Table D-23 summarizes the results of these hazard evaluations.

Table D-23. Onsite Transportation Hazards Evaluation Results

Type of Hazard	Risk
Chemical	Low (refer to Section D.3.6)
Explosives	Low (refer to Section D.3.7)
Biological	Low (refer to Section D.3.8)
Industrial	Standard industrial hazard
<HC-3 Radiological	Low
≥HC-3 Radiological	Low – evaluated on case-by-case basis

Source: DSAs, BIOS, and SADs.

Standard industrial hazards, such as use of chemicals with no known or suspected toxic properties, use of materials that are commonly available and used by the public, and use of small-scale quantities of chemicals that can be handled by one person when in use, such as in laboratories that do not have the potential for unmitigated release of hazards with impacts to the public, do not present an appreciable risk of health effects to co-located workers. Low hazard classification transportation activities are addressed by adherence to the HMRs.

Therefore, the accident scenarios associated with the onsite transportation of hazardous material are bounded by the DBAs presented in Sections D.3.5 through D.3.8.

D.3.10 Site-Wide Multiple-Building Scenarios

This section describes an assessment of potential accident scenarios that could involve multiple buildings. It specifically evaluates potential seismic events that could theoretically affect multiple facilities across the SNL/NM site. The potential frequencies and consequences of these events were derived from existing SNL/NM safety-basis documents.

This section also addresses the potential for wildfire events to involve multiple facilities with radiological or hazardous materials.

D.3.10.1 Seismic Event

Chapter 4, Section 4.4, describes the seismicity of the SNL/NM site. The maximum peak ground acceleration (PGA) for the TA-V area is estimated at 0.18 g (gravitational force equivalent) (USGS 2014); however, the ACRR DSA identifies the design-basis earthquake as a seismic event with a PGA of 0.22 g. The PGA values cited are based on a 2-percent probability of exceedance in 50 years, corresponding to an annual occurrence probability of about 1 in 2,500 or 0.0001 per year (“unlikely”).

Consistent with the 1999 SWEIS, this SWEIS evaluates the potential accident consequences of a design-basis seismic event that could occur in the region and estimates the consequence of this natural phenomenon hazard for each of the facilities with radiological materials. In addition, this section provides a conservative assessment of the potential offsite consequences if all the facilities in TA-V were affected by the same seismic event. This collection of facilities includes all the HC-2 facilities and the HC-3 facility on the SNL/NM site. Because the radiological facilities have radiological inventories less than HC-3 TQs, their contributions to offsite dose consequences, even in a site-wide seismic event, would be small in comparison to those from the HC-2 and HC-3 facilities. Later in this section, the potential consequences of multiple facilities that have notable inventories of hazardous chemicals are also discussed.

For the radiological analysis in this SWEIS, the potential population doses and LCFs associated with a seismic event for each of the facilities were summed because the facilities are all located in the same geographic area (TA-V). The analysis also sums the potential doses to the MOI; however, it is noted that this would be very conservative, because an individual would only receive a summed dose if the MOI were located along the line connecting the release points from two facilities and the wind were blowing along the same line at the time of the accident.

Under the No-Action and Modernized Operations Alternatives, the facilities included in this analysis of potential radiological consequences are the ACRR, SPR, and AHCU. As discussed in Section D.3.5.3, because there is the possibility that the CREST nuclear facility could be operating concurrently with the ACRR for some time under the Expanded Operations Alternative, this SWEIS assumes that the CREST facility would result in additional potential consequences, which would be the same as those analyzed for the ACRR.

The sum of the doses and estimated LCFs from each of these facilities appear at the end of Table D-24. Table D-25 provides the radiological fatality annual risk for each of these facilities. These results are presented for the average meteorological conditions.

In summary, Table D-25 demonstrates that the total accident risk to the offsite population as a result of multiple radiological facilities being involved in a design-basis seismic event would be about 0.000102 additional LCF per year. Under the Expanded Operations Alternative, that risk could increase slightly to about 0.000103 additional LCF per year.

The potential health effects presented for this postulated seismic event should also be considered within the context of the accompanying non-radiological human health impacts that would also be expected. The seismic event would cause widespread failures of non-nuclear SNL/NM structures, as well as structures outside of SNL/NM within the region of interest. Many more fatalities and injuries from structure collapse would be expected for this seismic event than those that result from radiological exposure.

For a site-wide seismic event, other facilities that have inventories of hazardous chemicals could also be at risk. For instance, Section D.3.6 addresses potential consequences of accidents involving the facilities in the MESA Complex, which is the facility with the largest inventory of hazardous chemicals at SNL/NM. As discussed in Section D.3.1.2, Table D-13, two facilities at SNL/NM require the preparation of an EPHA as a result of their inventory of hazardous chemicals: the MESA Complex and the HWHU. As discussed in the EPHA, the HWHU is a low-hazard facility and does not require the preparation of a safety-basis document like that prepared for the MESA Complex, which is a moderate-hazard facility (SNL 2021e and SNL 2023d). As such, the potential offsite consequences from hazardous chemical releases associated with a site-wide seismic event would be dominated by those presented in Section D.3.6 for the MESA Complex. The HWHU would be a minor contributor to the potential offsite consequences compared to those described in Section D.3.6.

Table D-24. Radiological Accident Frequency and Consequences of Design-Basis Seismic Event – Average Meteorology

Accident Scenario	Frequency (per year)	MOI ^{a, b}		Offsite Population ^c		Co-located Worker ^{b, d}	
		Dose (rem)	LCFs ^e	Dose (Person-rem)	LCFs ^e	Dose (rem)	LCFs ^e
Seismic/Fire-1: ACRR, TA-V: Design-basis seismic event collapses the ACRR structure and impacts associated equipment with an ensuing fire.	$<4 \times 10^{-4}$	6.41×10^{-2}	3.85×10^{-5}	257	0.15	1.81	1.09×10^{-3}
Seismic/Fire-2: SPR, TA-V: Design-basis seismic event collapses the SPR structure and impacts associated equipment with an ensuing fire.	$<4 \times 10^{-4}$	3.65×10^{-2}	2.19×10^{-5}	147	8.81×10^{-2}	1.03	6.18×10^{-4}
Seismic/Fire-3: AHCF/AHCU, TA-V: Design-basis seismic event collapses the AHCF/AHCU structure and impacts associated equipment with an ensuing fire.	$<4 \times 10^{-4}$	6.76×10^{-3}	4.06×10^{-6}	27.3	1.64×10^{-2}	0.19	1.14×10^{-4}
Dose and LCF Totals for <i>No-Action Alternative</i>		1.07×10^{-1}	6.45×10^{-5}	431	0.25	3.03	1.82×10^{-3}
Seismic/Fire-4: CREST Nuclear Facility, TA-V: Design-basis seismic event causes collapse of the CREST Complex and ensuing fire.	1×10^{-5}	6.41×10^{-2}	3.85×10^{-5}	257	0.15	1.81	1.09×10^{-3}
Dose and LCF Totals for Design-Basis Seismic/Fire Involved Facilities – <i>Expanded Operations Alternative</i>		1.71×10^{-1}	1.03×10^{-4}	688	4.05×10^{-1}	4.84	2.91×10^{-3}

a. Distance from each facility to its MOI is 1,350 meters.

b. The MOI and the co-located worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person and would be multiplied by the number of persons exposed.

c. Based on Table D-16.

d. Co-located worker is assumed to be located at a distance of 100 meters from the facility.

e. Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). Scientific notation is used to simplify the presentation; as a clarifying example, 3.85×10^{-5} is the same as 0.0000385, or one chance of an LCF in about 26,000 years.

Table D-25. Radiological Accident Fatality Annual Risk of a Design-Basis Seismic Event – Average Meteorology

Accident Scenario	MOI ^a (LCF ^b)	Offsite Population ^c (LCF ^b)	Co-located Worker ^d (LCF ^b)
Seismic/Fire-1: ACRR, TA-V: Design-basis seismic event collapses the ACRR structure and impacts associated equipment with an ensuing fire. Assumes provisional facility MAR of 20.6 kg of Pu-239 equivalent.	1.54×10^{-8}	6.00×10^{-5}	4.36×10^{-7}
Seismic/Fire-2: SPR, TA-V: Design-basis seismic event collapses the SPR structure and impacts associated equipment with an ensuing fire. Assumes provisional facility MAR of 14 kg of Pu-239 equivalent.	8.76×10^{-9}	3.52×10^{-5}	2.47×10^{-7}
Seismic/Fire-3: AHCF/AHCU, TA-V: Design-basis seismic event collapses the AHCF/AHCU structure and impacts associated equipment with an ensuing fire. Assumes HC-2 TQ of 2.61 kg of Pu-239 equivalent.	1.62×10^{-9}	6.56×10^{-6}	4.56×10^{-8}
Annual Risk Totals for Design-Basis Seismic/Fire Involved Facilities – No-Action Alternative	2.58×10^{-8}	1.02×10^{-4}	7.29×10^{-7}
Seismic/Fire-4: CREST Nuclear Facility, TA-V: Design-basis seismic event causes collapse of the CREST Complex and ensuing fire. Assumes provisional facility MAR of 20.6 kg of Pu-239 equivalent.	3.85×10^{-10}	1.50×10^{-6}	1.09×10^{-8}
Annual Risk Totals for Design-Basis Seismic/Fire Involved Facilities – Expanded Operations Alternative	2.62×10^{-8}	1.03×10^{-4}	7.40×10^{-7}

- The distance from each facility to its MOI is 1,350 meters.
- Annual risk is based on postulated frequency multiplied by the calculated dose multiplied by an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). Scientific notation is used to simplify the presentation; as a clarifying example, 3.52×10^{-5} is the same as 0.0000352, or one chance of an LCF in about 28,400 years.
- Based on Table D-16.
- Co-located worker is assumed to be located at a distance of 100 meters from the facility.

D.3.10.2 Wildfires

As most of the SNL/NM site is located in an area of light desert vegetation, forest fires are not a significant concern, except for facilities in the Withdrawn Area, such as the ACF. For the rest of the site, grass and range fires are a concern. Grass or range fires may result from lightning, especially during summer thunderstorms; from hot exhaust pipes on vehicles contacting tall, dry grass or vegetation along the road; or from discarded burning cigarettes and matches. A concern is that a grass or range fire burns near waste or material containers. If the fire intensity and duration are sufficient, a container lid might pop off and allow waste material to burn. A grass or range fire might also threaten structures, storage tanks, and persons. The safety documents and HAs for the various facilities address this type of accident. Vegetation and other combustible material are controlled around structures and outside storage facilities to limit their vulnerability to grass or range fires. Conduct of Operations Program controls include work restrictions on outside loading and unloading activities involving hazardous materials during adverse conditions such as a wildfire.

The KAFB Fire Department is trained to respond to grass and range fires. A grass or range fire is one of the potential initiators considered in the accident analyses that might start a larger building fire. The radiological impacts of a fire within a building initiated by a grass or range fire would be no larger than those of the postulated catastrophic events evaluated in this SWEIS, such as an aircraft crash and subsequent fuel-fed fire; however, a wildfire of such intensity that it could affect multiple buildings in TA-V is not considered credible and is not evaluated further in this SWEIS. As presented in Section D.3.10.1 for seismic events, each of the facilities affected by an earthquake is also assumed to be affected by an ensuing facility fire. Therefore, the potential site-wide impacts of an extremely unlikely wildland fire scenario that affects all of the buildings in TA-V would not be expected to be greater than the impacts presented in Table D-24.

D.4 INTENTIONAL DESTRUCTIVE ACTS

D.4.1 Introduction

DOE's *Recommendations for Analyzing Accidents under the National Environmental Policy Act* (DOE 2002) provides a schema for developing a range of accident scenarios to be analyzed for IDAs. Although IDAs (i.e., malevolent acts of sabotage or terrorism) are not accidents, their physical effects – whether caused by a fire, explosion, missile, or other impact force – may be compared to the effects of postulated accidents. The consequences of an act of sabotage or terrorism involving radioactive and hazardous materials with environmental and/or health risks can then be compared to the accident analyses documented in this SWEIS.

D.4.2 Assessment of Vulnerability to Terrorist Threats

In accordance with DOE Order 470.3C (DOE 2020c) and DOE Order 470.4B (DOE 2021d), NNSA conducts vulnerability assessments and risk analyses of the facilities and sites under its management to evaluate the possible threats and the protection elements, technologies, and administrative controls used to protect against these threats. DOE Order 470.4B establishes the roles and responsibilities for the conduct of DOE's Safeguards and Security Program. DOE Order 470.3C establishes requirements designed to prevent unauthorized access, theft, diversion,

or sabotage (including unauthorized detonation or destruction) of all nuclear weapons, nuclear weapons components, and special nuclear material (SNM) under DOE's control. Among other provisions, the order (1) specifies those national security assets that require protection, (2) outlines threat considerations for safeguards and security programs to provide a basis for planning, design, and construction of new facilities or modifications to existing facilities, and (3) provides an adversary threat basis for evaluating the performance of safeguards and security systems. NNSA also protects against espionage, sabotage, and theft of radiological, chemical, or biological materials; classified matter; non-nuclear weapon components; and critical technologies.

NNSA's safeguards and security programs and systems employ state-of-the-art technologies to:

- deny access to nuclear weapons, nuclear test devices, and completed nuclear assemblies;
- prevent theft, sabotage, or an unauthorized nuclear yield (criticality) of SNM and credible rollup quantities of SNM;
- protect the public and employees from unacceptable impacts resulting from an adversary's use of radiological, chemical, or biological materials; and
- protect classified matter and designated critical facilities and activities from sabotage, espionage, and theft.

NNSA's vulnerability assessments employ a rigorous methodology. Typically, a vulnerability assessment involves analyses of modeling, simulation, and performance testing results by subject matter experts to determine the effectiveness of a safeguard and security system against an adversary's objectives. Vulnerability assessments generally include the following activities.

Characterizing the threat. Threat characterization describes in detail a physical threat by a malevolent adversary to a site's physical protection systems. Usually, the description includes information about potential adversary types, motivations, objectives, actions, physical capabilities, and site-specific tactical considerations. Much of the information required to develop a threat characterization is described in DOE Order 470.3C and the Adversary Capabilities List. DOE also issues additional site-specific threat clarification and guidance.

Determining the target. Target determination involves identifying, describing, and prioritizing potential targets among NNSA's security interests that meet the criteria outlined in DOE Order 470.3C. Target determination results are used to help characterize potential threats and target facilities, as well as protective force and neutralization requirements.

Defining the scope. The scope of a vulnerability assessment is determined by agreement among DOE Headquarters and field staff and contractor personnel. In addition to defining the threat and applicable targets to be assessed, the scope establishes the key assumptions and interpretations that will guide the analyses, as well as the objectives, methods, schedule, personnel responsibilities, and format for documenting the results of the assessment.

Characterizing the facility or site. This activity requires defining and documenting aspects of the facility or site, particularly existing security programs (personnel security, information security, physical security, material control and accountability, etc.), to assist in identifying

strengths and weaknesses. Results are used as inputs to the pathway analyses used to develop representative case scenarios for evaluating the security system.

Characterizing the protective force. To assess a facility or site's vulnerability, analysts must accurately characterize the associated protective force's capabilities against a defined threat and objective, particularly the force's ability to detect, assess, respond to, interrupt, and neutralize an adversary. Specific data used for this activity include SNM categorization; configuration, flow, and movement of SNM within or from a facility or site; defined threats; detection and assessment times; and adversary delay and task time. The characterization also considers the protective force's equipment, weapons, number, and locations. The characterization information is validated and verified via observation, alarm response assessments, limited scope performance tests, force-on-force exercises, joint conflict and tactical simulations, and tabletop analyses.

Analyzing adversary pathways. This activity identifies and analyzes base case adversary pathways based on the results of threat, target, facility, and protective force characterization, as well as ancillary analyses such as explosives analysis. Analysts use modeling tools and conduct insider analysis as part of this activity.

Developing base case scenarios. Base case scenarios are developed for use in performance testing and to determine the effectiveness of the security system in place against a potential adversary's capabilities and objectives. As part of this activity, data from the base case adversary pathways analyses are used to identify applicable threats, threat strategies, and objectives, and combined with protective force strategies and capabilities to develop scenarios that include specific adversary resources, capabilities, and projected task times to successfully complete their objectives. Specialists also work with the vulnerability assessment team to develop realistic scenarios that provide a structured, intellectually honest analysis of the strengths and weaknesses of the terrorist adversary.

Determining the probability of neutralization. The probability of neutralization is a numeric value representing the probability that the protective force can prevent an adversary from achieving its objectives. The calculated number is derived from more than one source, one of which must be based on Joint Tactical Simulation analysis, or force-on-force exercises.

Determining system effectiveness. System effectiveness is determined by applying an equation that reflects the capabilities of a multi-layered protection system. Analysis data derived from the various vulnerability assessment activities are used to calculate this equation, which reflects the security system's effectiveness against each of the scenarios developed for the vulnerability assessment. If system effectiveness is unacceptable for a scenario, the root cause of the weakness must be analyzed and security upgrades must be identified. The scenarios are reanalyzed with the upgrades, and the successful upgrades are documented in the vulnerability analysis report.

Implementation. The vulnerability assessment culminates in a report documenting the analyses and results and a plan for implementing any necessary upgrades to achieve the required security system effectiveness. NNSA verifies the results of the vulnerability assessment report and the conclusions of the implementation plan. NNSA also provides management oversight of the actual implementation of security system upgrades.

D.4.3 Intentional Destructive Acts Analysis

Substantive details of IDA scenarios and security countermeasures are not released to the public because terrorists could exploit disclosure of this information to plan attacks. Depending on the malevolent acts, terrorist acts, or IDAs, impacts may be similar to or could exceed bounding accident impact analyses prepared for this SWEIS.

In accordance with the requirements in DOE Order 470.3C and NNSA SD 470.4-2 (NNSA 2021), SNL/NM has conducted a Security Risk Assessment, which includes various IDAs to hazardous materials, and reported any potential security risks to their federal oversight for acceptance or mitigation determination.

Facilities and locations involving sufficient radioactive or hazardous material to result in potentially severe impacts are protected by numerous physical, procedural, and operations-based systems that minimize the probability of a successful IDA. In the unlikely event an actual IDA occurred, the facilities/locations have physical features that would reduce potential impacts for most IDA scenarios. DOE/NNSA security and response teams are trained and prepared to respond to an IDA to further reduce potential impacts.

D.5 EMERGENCY MANAGEMENT

D.5.1 Introduction

DOE Order 151.1E (DOE 2024) requires that each NNSA/DOE site establish and maintain a documented emergency management program that implements the requirements of applicable federal, state, and local laws, regulations, and ordinances for fundamental worker safety programs (e.g., fire, safety, security). SNL/NM has prepared the *Sandia National Laboratories, New Mexico Emergency Management Plan* (SNL 2021f) to comply with this requirement and to document SNL/NM's comprehensive emergency management program.

The Emergency Management mission at SNL/NM is to protect life, property, the environment, and the organization's reputation by collaborating and coordinating with all stakeholders to enable the implementation and sustainment of a comprehensive emergency management system. The Emergency Management Plan establishes a site-level emergency response organization (ERO) that is responsible for addressing the specific hazards analyzed in EPHAs, which were identified in an all-hazards survey conducted for the SNL/NM site. The ERO uses proven techniques that include policies and procedures, equipment, training, drills, and exercises needed to successfully respond and deal with a range of emergencies.

The Emergency Management Plan covers the basic elements of preparedness, response, and recovery, which include the following:

- All-hazards planning basis
- Emergency categorization
- Training and drills
- Emergency operation system and readiness assurance
- Emergency medical support

- Offsite response interfaces
- Emergency facilities, equipment, and systems
- Protective actions and re-entries
- Notifications and communications
- Emergency public information (EPI)
- Consequence assessment
- Termination and recovery

An operational emergency is a major unplanned or abnormal incident or condition that involves or affects DOE facilities and activities by causing or having the potential to cause serious health and safety or environmental impacts and requires additional resources to supplement the planned initial response offsite. Operational emergencies are classified based on health effects parameters measured or estimated at 30 meters, 100 meters, and the site boundary and compared with the appropriate PAC. The emergencies are classified by the following three levels of increasing severity:

1. **Alert:** Declared when an incident is predicted, in progress, or has occurred in which an actual or potential substantial degradation in the level of control over hazardous materials exists. DOE Order 151.1E (DOE 2024) further defines an alert as, “The radiation dose from any release to the environment of radioactive material or a concentration in air of hazardous chemical material is expected to exceed the applicable protective action criterion at or beyond 30 meters but not beyond 100 meters from the point of release or beyond the site boundary.”
2. **Site Area Emergency:** Declared when an incident is predicted, is in progress, or has occurred in which the radiation dose from any release of radioactive material, or concentration in air from any release of other hazardous material, is expected to exceed the applicable PAC at or beyond 100 meters from the point of release but not at or beyond the site boundary.
3. **General Emergency:** Declared when an incident is predicted, is in progress, or has occurred in which the radiation dose from any release of radioactive material, or a concentration in air from any release of other hazardous material, is expected to exceed the applicable PAC at or beyond the site boundary.

An ERO is maintained for the entire SNL/NM site and to support remote sites and leased spaces, as needed. The ERO comprises positions that are required during an emergency:

Communications Center personnel, the SFO representative, a Duty Officer, Emergency Operations Center (EOC) positions, Protective Force personnel, Employee Health Services personnel, internal technical experts, and the KAFB ERO. The KAFB ERO includes, among other organizations, KAFB Fire Emergency Services (KFES), Explosives Ordinance Disposal, and other response entities as defined in the Base Support Agreement.

D.5.2 All-Hazards Technical Planning Basis

The All-Hazards Survey of SNL/NM facilities is conducted and updated every 3 years and when there are significant changes to site, facility, or activity operations or to hazardous materials inventories. If the All-Hazards Survey identifies hazardous materials at a facility or site that

exceed predetermined thresholds, a facility- or site-specific EPHA is prepared. EPHAs are used to define Emergency Management Hazardous Materials Program provisions, ensuring that the program is commensurate with the hazards identified. An EPHA identifies and characterizes hazardous materials specific to a facility or site, analyzes potential accidents or incidents including severe events, and evaluates potential consequences. The EPHA provides the basis for establishing a graded approach that will meet the program requirements outlined in DOE Order 151.1E (DOE 2024). The Emergency Management Program identifies specific hazardous materials and quantities that, if released, could produce impacts consistent with the definition of an operational emergency.

Currently, three facilities or sites at SNL/NM have an EPHA: TA-V, the MESA Complex, and the HWHU/Transportation.

EALs are predetermined, site-specific, observable thresholds for an initiating condition that, when met or exceeded, place the site in an emergency categorization for further classification. Each EAL has associated protective action distances that are intended to protect members of the workforce and the public from releases of hazardous materials.

Each facility with an EPHA has a facility-specific emergency planning zone (EPZ), which is determined and documented in the EPHA by Technical Planning Basis. A site-wide consolidated EPZ defines the geographic area in the local community within which special planning and preparedness activities are required to reduce the potential health and safety impacts from an incident at SNL/NM involving hazardous materials.

DOE guidance is oriented toward using a step-by-step process and tests of reasonableness when developing an EPZ for each facility on a site or installation. In general, the site EPZ for SNL/NM must include a large enough area so that:

- protective actions are not likely to be required beyond the EPZ for most analyzed incidents,
- planning efforts within the EPZ provide a substantial base for expanding response efforts beyond the EPZ if necessary, and
- measures taken within the EPZ provide for a substantial reduction in early lethality for all analyzed incidents (i.e., consequences from all analyzed incidents shall not exceed thresholds for early lethality outside the EPZ).

D.5.3 Training and Drills

SNL/NM provides new employees with emergency management information and instructions for what to do in an emergency. All members of the workforce receive documents such as a building emergency plan and an emergency handbook, which identify hazards, protective action procedures, self-help strategies such as first-aid, and the location of onsite medical and life-sustaining resources.

The ERO Training Program provides training to support site-level ERO needs and to give ERO personnel basic knowledge of emergency management topics, fundamentals, and responsibilities

while meeting regulatory requirements. The program also provides general instruction for all personnel on the proper response to emergencies and, for controllers and evaluators, training that will enable them to adequately control and evaluate drills and exercises. In addition, technical specialists and offsite response personnel receive emergency management training to handle specialized emergency situations.

Drills are supervised, hands-on training used to develop and maintain personnel skills, expertise, proficiency, and response capabilities. Emergency drills are of sufficient scope and frequency to ensure adequate response capabilities in all applicable areas. The drill scenarios align with hazards/threats (i.e., accidents or emergencies) identified in the all-hazards planning basis, including those analyzed in the all-hazards survey or specific EPHAs for the respective facility/activity. Drills are also designed to address specific activities within the SNL/NM mission set (e.g., notification, categorization and classification, emergency communication, fire and medical response, hazardous materials detection and monitoring, security/law enforcement incidents, personnel accountability and evacuation, decontamination, public information, radiological control).

KFES conducts training in accordance with DoD and KAFB regulations and directives. KAFB personnel receive training on SNL/NM hazards and consequences no less than annually. Annual KAFB training requirements are coordinated with SFO to support the NNSA mission. SFO also formally invites applicable offsite first responders, including state and county agencies, to participate in a relevant drill or exercise at least annually.

D.5.4 Emergency Operations System

The Emergency Operations System supports on-scene response during an emergency incident by relieving the burden on site-level and external communication and securing additional resources needed for the response. The Emergency Management Program establishes an emergency operations system to provide strategic management, operational support, planning/intelligence, logistics, and finance/administration. It does not provide tactical direction to the Incident Commander in the field. This is satisfied through the EOC.

The main functions of the EOC are to collect, analyze, and share information; determine incident priority; support incident resource needs and requests; develop incident and EOC planning; support relevant incident management policies and interagency activities; coordinate with other operations centers and multiagency coordination groups; coordinate with SNL/NM leadership, SFO, KAFB, and elected and appointed officials; and coordinate summary information.

The EOC is activated at the appropriate level for any declared operational emergency impacting the site, or it may activate for other significant incidents and planned events when emergency management and leadership decide that support operations would be advantageous. The EOC may be activated at three different staffing levels based on the incident (e.g., severity, type, location, consequences) and support needed. Figure D-3 provides the staffing for the EOC at various activation levels.

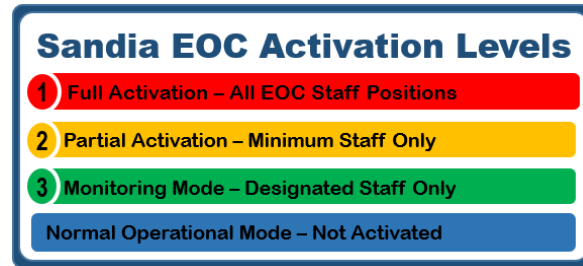


Figure D-3. Staffing Levels for the EOC

D.5.5 Protective Actions

Protective actions are measures taken to minimize the consequences of emergencies and to protect the health and safety of workers and the public. Initial protective actions for workers are outlined in the respective building emergency plans. The Incident Commander can assess the incident and use standard industry practices for implementing initial immediate protective actions. Additionally, the Incident Commander may coordinate with SNL/NM representatives to further refine protective actions. Protective actions could include:

- **Shelter-in-place.** A protective action taken to protect workers from potential incident hazards (e.g., a hazardous materials release) by having them seek shelter if outdoors and/or remaining indoors and taking refuge. A shelter-in-place protective action directs workers to seek shelter within their current facility or the one closest to them if caught outdoors. Shelter-in-place actions may be used during various incidents (e.g., hazardous material releases, inclement weather, bomb threats, other direct or indirect threats to a general area).
- **Evacuation.** Directed relocation of a population out of a high-risk area prior to or during an emergency. The evacuation of a site may be necessary when a hazard (e.g., a structure fire), whether natural or man-made, threatens the safety of those within the site. Evacuation protective actions direct workers to leave a facility, area, or base safely, based on directions from the Incident Commander, EOC, or SNL/NM Leadership Team. Upon receiving the order to evacuate, each worker proceeds to a predetermined assembly point or leaves the area or KAFB. Evacuation may be used during various incidents (e.g., fire, hazardous material releases, imminent inclement weather, bomb threats, other direct or indirect threats to a general area).
- **Lockdown.** The action taken to secure (as best possible) a facility, building, or room to deny entry or exit to protect workers and others within the space from harm or discovery by an active assailant (e.g., an active shooter) who **is not** in the immediate vicinity. When in the immediate vicinity of a threat (e.g., an active shooter), workers are encouraged to follow the run, hide, and fight options.

D.5.6 Emergency Medical Support

Medical support at SNL/NM encompasses immediate medical care and provisions for onsite and offsite care and treatment. KFES and SNL/NM emergency management personnel respond to all

medical services emergencies on DOE-owned and permitted property used by SNL/NM personnel and, as needed, to preapproved events offsite.

The Emergency Medical Support Program provides the following:

- planning for medical treatment associated with incidents identified in the all-hazards planning basis (e.g., mass casualty situations, treatment of onsite responders);
- provisions for sharing of patient information between onsite and offsite health care providers during emergencies; and
- the process to transport, accept, and treat contaminated and injured personnel.

Employee Health Services personnel provide primary emergency medical support response and KFES provides secondary emergency medical support. Emergency medical support comprises basic, intermediate, and advanced life support, including triage, treatment, and transport to the appropriate healthcare facility. KFES is the primary service for coordinating, delivering, and landing emergency medical air assets, if requested.

Lovelace Health System, Presbyterian Healthcare Services, and the Regents of the University of New Mexico provide emergency medical services at local healthcare facilities for emergencies at SNL/NM that would require treatment and care of any individual for injuries and illnesses or decontamination associated with exposure to radiological and/or other hazardous material, as well as chemical, biological, and nuclear acts of terrorism, that are beyond the capabilities of the SNL Employee Health Services.

D.5.7 Offsite Response Interfaces

DOE sites, facilities, and activities must establish and maintain interfaces with local, state, tribal, and federal organizations responsible for emergency response or that may be used to supplement response capabilities based on threats or hazards identified in the all-hazards planning basis, including planning for severe events.

Federal Agencies. In addition to DoD, several other federal agencies may support DOE/NNSA. These include the Federal Emergency Management Agency and the Federal Bureau of Investigation.

State Agencies. DOE would coordinate, as appropriate, with several state agencies, including but not limited to, the New Mexico Department of Homeland Security and Emergency Management, the New Mexico State Police, the New Mexico Department of Health, and the New Mexico Environment Department.

Local Agencies. The establishment of an effective interface and coordination is a vital element of a regional incident management strategy that provides critical support, resources, and information to those agencies and organizations impacted. The primary local jurisdictions that SNL/NM interfaces with include:

- City of Albuquerque
 - City of Albuquerque Office of Emergency Management
 - Albuquerque Fire Rescue
 - Albuquerque Police Department
 - Albuquerque International Sunport
- Bernalillo County
 - Bernalillo County Office of Homeland Security and Emergency Preparedness
 - Bernalillo County Fire Department
 - Bernalillo County Sheriff's Office

Tribal Governments. SNL/NM Emergency Management Program personnel coordinate with SNL/NM's Government Relations Program personnel to interface with the Pueblo of Isleta, involving tribal members in emergency planning and providing them opportunities to participate in emergency trainings, drills, and exercises. SNL/NM personnel notify tribal agencies of incidents that might impact their area.

D.5.8 Emergency Public Information

The EPI Program is consistent with the all-hazards planning basis and ensures that accurate, candid, and timely information is provided to SNL/NM personnel, the news media, and the public during an emergency to establish facts and avoid speculation. EPI activities are coordinated with DOE and NNSA and, if appropriate, local, state, federal, and tribal governments.

The EPI Program includes the following functions:

- Identify personnel, resources, and facilities to support EPI activities.
- Coordinate information during an emergency.
- Identify a location for briefings and news conferences.
- Coordinate public information with offsite response agencies.
- Review information to ensure that no sensitive information is released.
- Provide for approval by the field element and coordinate with the DOE Headquarters EOC Public Affairs Watch Officer.

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APPENDIX E

TRANSPORTATION

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Appendix E – Transportation

E.1 OVERVIEW

Transportation of any commodity involves a risk to both transportation crew members and members of the public. This risk results directly from transportation-related accidents and indirectly from increased levels of pollution from vehicle emissions, regardless of the cargo. The transport of certain materials, such as radioactive materials and waste, can pose an additional risk due to the unique nature of the material itself. Per U.S. Department of Energy (DOE) National Environmental Policy Act of 1969 (NEPA) requirements to facilitate a comparison of the likely sources of potential high-consequence environmental impacts among the three alternatives for continued operations of Sandia National Laboratories, New Mexico (SNL/NM), this *Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico* (DOE/EIS-0556) (SNL/NM SWEIS) (and specifically this appendix), focuses on the potential human health risks associated with the transportation of radioactive materials and waste to and from SNL/NM on public roadways. Such radiological human health impacts would typically be greater than any human health impacts that could theoretically result from the release of SNL-generated hazardous waste streams from a transportation accident.

As such, this appendix provides an overview of the approach used to assess the human health risks that could result from transportation of radiological materials and wastes between SNL/NM and several potential destinations across the DOE/National Nuclear Security Administration (NNSA) complex in the United States. The topics in this appendix include the overall scope of the subject transportation impact evaluation (Section E.2), packaging (Section E.2.2), determination of potential shipping routes (Sections E.3.1, E.3.8, and E.5.3), the specific analytical methods employed for the impact evaluation (e.g., computer models, scaling) (Section E.3), and other key supporting assumptions used in the analysis (Section E.3). In addition, to help with understanding and interpreting the evaluation results, Section E.5 describes specific areas of uncertainty, with an emphasis on how those uncertainties may affect comparisons of impacts among the distinct alternatives.

The regulations in Title 49 of the *Code of Federal Regulations* (CFR) Parts 171–178 establish maximum permissible package dose rates, maximum permissible dose rates to vehicle crew members, exclusive-use shipment criteria, packaging certification conditions, and other features of radioactive materials transportation. NNSA uses the Radioactive Material Transportation Risk Assessment (RADTRAN) model to assess human health risks that may result from the transport of radioactive material and waste cargo traveling along highway routes within rural, suburban, and urban population zones. Potential impact results are presented in this appendix in terms of cumulative risks for incident-free transportation conditions (over the 15-year duration of the SWEIS analysis) as well as annualized risks for postulated transportation-accident conditions. To assess impacts (both radiological and non-radiological) for either type of condition (incident-free or accident risks), NNSA relied upon calculated total shipment miles to estimate overall risks to various receptors (e.g., public, crews, inspectors) between a given origin and destination. Calculated transportation impact risks in this SWEIS were derived from the normalized RADTRAN-generated “risks-per-shipment” (per material form) provided in the 2008 Los Alamos National Laboratory (LANL) SWEIS (NNSA 2008), with associated presumed travel routes continuing to occur along interstate highways/freeways to the greatest extent practicable.

These normalized risk values from the 2008 LANL SWEIS were then applied to this SNL/NM SWEIS's assumptions for projected numbers of shipments (per material form) associated with each of the three alternatives being evaluated. In support of accident evaluations, qualitative assumptions regarding applicable characteristics and regulations for the transport of explosive materials were also integrated into the assessment process (refer to Section E.6).

This appendix also evaluates potential impacts to onsite traffic/transportation by discussing other potentially measurable impacts to SNL/NM workforces and/or the local environment.

Projected changes of hazardous waste shipment numbers associated with each alternative are presented in Chapter 5, Section 5.11, of this SWEIS. This appendix does not echo those results, nor does it focus on quantitatively assessing any potential health impacts associated with the shipment of individual chemical constituents/sources within those waste streams. Additional information about this topic is given in Chapter 5, Section 5.13, of this SWEIS.

E.2 ASSESSMENT SCOPE

This section describes the scope of the transportation human health risk evaluation, including transportation activities, applicable packaging and transportation regulations, transportation modes, and emergency response. The applied assessment methodology and derived radiological impacts that follow are addressed in Sections E.3 and E.4, respectively.

E.2.1 Transportation-Related Activities

The transportation risk evaluation focuses on potential human health risks related to each transportation alternative in this SWEIS. This includes incident-free risks to persons in the vicinity of a shipment during transport or at stops, as well as accident risks. This appendix also addresses the impacts of increased transportation levels on local traffic flows or infrastructure.

E.2.2 Packaging and Transportation Regulations

The packaging and transportation of radioactive materials and wastes are highly regulated. The U.S. Department of Transportation (DOT) and the U.S. Nuclear Regulatory Commission (NRC) have primary responsibility for federal regulations governing commercial radioactive materials and waste transportation. In addition, DOE works with DOT and NRC in developing requirements and standards for radioactive materials and waste transportation. DOE, including NNSA, has broad authority under the Atomic Energy Act of 1954 (AEA) (42 *United States Code* [U.S.C.] § 2011 et seq.) to regulate all aspects of activities involving radioactive materials and waste undertaken by DOE or on its behalf, including the transportation of radioactive materials and waste. While DOE can regulate under the AEA, most shipments are performed by approved commercial carriers operating under DOT and NRC rules.

The regulatory standards for packaging and transporting radioactive materials and waste cargo are designed to achieve the following four primary objectives:

- Protect persons and property from radiation emitted from packages during transportation by specific limitations on allowable radiation levels.

- Contain radioactive material and waste in the package (achieved by meeting packaging design requirements that are based on performance-oriented packaging integrity tests and environmental criteria).
- Prevent nuclear criticality (an unplanned nuclear chain reaction that could occur because of concentrating too much fissile material in one place).
- Provide physical protection against theft and sabotage during transit.

The DOT regulations in 49 CFR Parts 106, 107, and 171–178 pertain to the ground transportation of radioactive materials and waste cargo published by DOT; the NRC regulations are at 10 CFR Parts 20, 61, 71, and 73. International Civil Aviation Organization regulations for shipment via aircraft can be found in the organization’s published criteria regarding hazardous cargo protocols. For the U.S. Postal Service, Publication 52, *Hazardous, Restricted, and Perishable Mail* (USPS 2023), specifies the quantities of radioactive material and waste prohibited in surface mail. Interested readers are encouraged to visit the cited resources for the most current regulations, review DOT’s *Radioactive Material Regulations Review* (DOT 2008) for a comprehensive discussion on radioactive material and waste cargo regulations, or review DOT’s Radioactive Materials website at <https://www.phmsa.dot.gov/research-and-development/hazmat/radioactive-materials>.

E.2.2.1 Packaging Regulation Specifics

Packaging represents the primary barrier between the radioactive material and waste cargo being transported and radiation exposure to the public, workers, and the environment. Transportation packaging for radioactive materials and waste must be designed, constructed, and maintained to contain and shield its contents during normal transport conditions. For radioactive material, such as special nuclear material (SNM), and waste, packaging must contain and shield the contents in the event of severe accident conditions. The type of packaging used is determined by the total radioactive hazard presented by the material or waste within the packaging. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. Specific requirements for these packages are detailed in 49 CFR Part 173, Subpart I, on Class 7 (radioactive) materials. All packages are designed to protect and retain their contents under normal operations. Packages typically shipped from or received by SNL/NM are either Excepted, Type A, or Type B:

- Excepted packaging is limited to transporting materials and waste that present a limited hazard to the public and the environment, because of their extremely low levels of radioactivity and very low external radiation dose (e.g., depleted uranium).
- Type A packaging, typically a 55-gallon drum or metal boxes, is commonly used to transport radioactive materials or waste with higher concentrations or amounts of radioactivity than that transported in Excepted packages. Type A packaging is designed to protect and retain its contents under normal transport conditions. Furthermore, it must maintain sufficient shielding to limit radiation exposure to handling personnel.
- Type B packaging is used to transport material or waste with the highest radioactivity levels, is designed to protect and retain its contents under normal and severe-accident conditions, and must maintain sufficient shielding to limit radiation exposure to handling personnel. DOE/NNSA uses numerous Type B package designs to transport radioactive

materials or waste. Packages are selected based on the purpose and contents for which they will be used. DOE typically uses the TRU Package Transporter-II (TRUPACT-II) for contact-handled transuranic (TRU) waste shipments. The TRUPACT-II is a large cask that can contain multiple smaller packages. It includes armor, impact limiters, and thermal insulation. Other similarly robust transporters, such as the HalfPACT or TRUPACT-III, may also be used. For SNM transport, 9975 and 9977 containers are also regularly used Type B packages (49 CFR Part 173, Subpart I; SIMCO 2024).

Compliance with packaging requirements is demonstrated by using a combination of simple calculation methods, computer simulation techniques, scale modeling, or full-scale testing of transportation packages or casks.

E.2.2.2 Transportation Regulation Specifics

DOT regulates the transportation of hazardous materials, including explosives, radioactive materials, and radioactive wastes, in interstate commerce by land, air, and water. DOT specifically regulates the carriers of radioactive materials and waste cargo and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements. DOT also regulates the labeling, classification, and marking of radioactive material and waste packaging.

NRC regulates packaging and transportation of radioactive material and waste for its licensees, including commercial shippers of radioactive materials and waste. Under an agreement with DOT, NRC sets standards for packages containing fissile materials and for Type B packaging.

DOE, through its management directives, orders, and contractual agreements, ensures the protection of public health and safety by imposing on its transportation activities standards that meet those of DOT and NRC. DOT recognizes in 49 CFR 173.7(d) that packaging made by or under the direction of DOE may be used for transporting Class 7 materials (radioactive materials and radioactive waste) when the packages are evaluated, approved, and certified by DOE against packaging standards equivalent to those specified in 10 CFR Part 71.

DOT also has requirements that help reduce transportation impacts, including requirements that affect drivers, packaging, labeling, marking, and placarding. Other requirements specify the maximum dose rate of radioactive materials and/or waste shipments to limit doses during incident-free transportation. Dose rate requirements for shipments are under 49 CFR 173.441.

In general, numbers of shipping containers per shipment are estimated on the basis of the dimensions and weight of the shipping containers, the Transport Index (which is the dose rate at 3.3 feet [1 meter] from the container), and the transport vehicle dimensions and weight limits. The impacts evaluation in this SWEIS assumes that the various materials assumed to be shipped would be transported in a single stack aboard a legal-weight transport vehicle.

Of note, an exclusive-use shipment is defined as a *sole use* case by a single consignor of a conveyance for which all initial, intermediate, and final loading and unloading (as well as the shipment itself) are carried out in accordance with the direction of the consignor or consignee as required by 49 CFR 173.403. The consignor and the carrier must ensure that any loading or unloading is performed by personnel having radiological training and resources appropriate for safe handling of the consignment. The consignor must also provide to the initial carrier specific

written instructions for maintenance of exclusive-use shipment controls, including vehicle survey requirements as applicable, and include these instructions with the shipping paper information given to the carrier by the consignor (49 CFR 173.403).

E.2.3 Transportation Modes

Radioactive materials transportation. For radioactive material (non-waste) transportation scenarios evaluated in this SWEIS, NNSA’s Office of Secure Transportation performs any such shipments (i.e., SNM-related), which consists of safeguard-truck-transport. Of note, shipments involving transport of *strategic* SNM, such as plutonium (Pu) metal or highly enriched uranium, *always* exclusively use safeguard-truck-transports, regardless of circumstance (NNSA 2023a).

Radioactive and hazardous waste transportation. For radioactive and hazardous waste transportation scenarios evaluated in this SWEIS, all such shipments are conservatively assumed to use commercial tractor-trailer vehicles. TRU waste shipments to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, NM, are typically transported via trucks with trailers specially designed to handle the heavy weight and large load dimensions of the shipments.

E.2.4 Emergency Response

The U.S. Department of Homeland Security (DHS) is responsible for establishing policies for, and coordinating civil emergency management, planning, and interaction with, federal executive agencies that have emergency response functions in the event of a transportation incident. If a transportation incident involving nuclear material or waste occurs, guidelines for response actions have been outlined in the National Response Framework.

The Federal Emergency Management Agency, an organization within DHS, coordinates federal and state participation in developing emergency response plans and is responsible for the development and the maintenance of the *Nuclear/Radiological Incident Annex* to the National Response Framework (DHS 2016). The National Response Framework and its annex describe the policies, situations, concepts of operations, and responsibilities of the federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactivity to address the consequences of the event.

DHS has the authority to activate Nuclear Incident Response Teams, which include DOE Radiological Assistance Program Teams that can be dispatched from regional DOE offices in response to a radiological incident. These teams provide first-responder radiological assistance to protect the health and safety of the public, responders, and the environment and to assist in the detection, identification and analysis, and response to events involving radiological/nuclear material or waste. Deployed teams provide traditional field monitoring and assessment support, as well as a search capability.

DOE uses DOE Order 151.1E, *Comprehensive Emergency Management System* (DOE 2024), as a basis to establish a comprehensive emergency management program that provides detailed, hazard-specific planning and preparedness measures to minimize the health impacts of accidents involving loss of control over radioactive material and chemicals/biologicals. DOE provides technical assistance to other federal agencies and to state and local governments. Contractors are responsible for maintaining emergency plans and response procedures for all facilities,

operations, and activities under their jurisdiction and for implementing those plans and procedures during emergencies. Contractor and state and local government plans are fully coordinated and integrated. In addition, DOE established the Transportation Emergency Preparedness Program (<http://teppinfo.com/>) to ensure its operating contractors and state, tribal, and local emergency responders are prepared to respond promptly, efficiently, and effectively to accidents involving DOE shipments of radioactive material. This program is a component of the overall emergency management system established by DOE Order 151.1E.

In the event of a release of radiological cargo from a shipment along a route, local emergency response personnel would be first to arrive at the accident scene. NNSA expects that response actions would be taken in context of the *Nuclear/Radiological Incident Annex*. Based on an initial assessment at the scene, their training, and available equipment, first responders would involve state and federal resources as necessary. First responders and/or state and federal responders would initiate actions in accordance with the DOT *Emergency Response Guidebook* (DOT 2024) to isolate the incident and perform any actions necessary to protect human health and the environment (such as evacuations or other means to reduce or prevent impacts to the public). Cleanup actions are the responsibility of the carrier. DOE would partner with the carrier, shipper, and applicable state and local jurisdictions to ensure cleanup actions meet regulatory requirements.

To mitigate the possibility of an accident, DOE issued DOE Order 460.2B, *Departmental Materials Transportation Management* (DOE 2022a). As specified in this order, carriers are expected to exercise due caution and care in dispatching shipments. According to the order, the carrier determines the acceptability of weather and road conditions, whether a shipment should be held before departure, and when actions should be taken while enroute. The order emphasizes that shipments should not be dispatched if severe weather or bad road conditions make travel hazardous. Conditions at the point of origin and along the entire route would be considered.

E.3 IMPACT ASSESSMENT METHODOLOGY

E.3.1 General Routing Assumptions

Under the alternatives, all radiological shipments (materials and wastes) are conservatively assumed to be transported exclusively by truck (i.e., no rail or air). This assumption results in the highest estimated worker and population doses. This does not altogether preclude the use of potential air transport on a situational basis as needed, however, since this mode of transportation has occurred in the past and could continue in the future. No matter what distance is to be traveled for ground shipments, shipments would be expected to use the most direct route(s) that minimize radiological risks. Shipments leaving the immediate Albuquerque area for in-state or out-of-state destinations (e.g., Nevada, California) would be transported over federal highways for most of their routes. Section E.3.8 and Table E-1 through Table E-4 contain additional information.

E.3.2 Population Projections

Directly feeding into the original determination of per-shipment impacts in the 2008 LANL SWEIS (discussed in Section E.1), the Transportation Routing Analysis Geographic Information

System (TRAGIS) computer program (Johnson and Michelhaugh 2003) was employed to choose transportation routes in accordance with DOT regulations. TRAGIS data used in the evaluation were based on U.S. Census Bureau population estimates for 2000 along the various shipping routes and were accordingly scaled upward in the 2008 LANL SWEIS to reflect population projections over future years (e.g., circa 2020) of its Proposed Action periods. This future-year scaling was deemed appropriately representative for direct use within this SNL/NM SWEIS appendix's transportation risk evaluations given that these evaluations commence in 2025.

E.3.3 Receptors Evaluated

Estimates of potential radiological impacts to various receptor groups (e.g., public, truck crews, inspectors) were made for this SWEIS's transportation risk analysis. Specific cohorts within each of these receptor groups include:

- members of the public residing or temporarily situated near/along transportation routes (within 0.5 miles [800 meters] of each side of a traversed roadway),
- nearby people in adjacent vehicles along shipping routes,
- nearby people at rest areas and stops (e.g., gasoline stations) along shipping routes,
- truck transport crews (two drivers per shipment),
- truck/cargo inspectors,
- a public maximally exposed individual (MEI) located 330 feet (100 meters) directly downwind from a transportation accident location,
- public population within 50 miles (80,467 meters) of an accident location, and
- a first responder at a distance less than or equal to 0.006 mile (10 meters) of an accident location.

E.3.4 Scaling Approach

As explained in Section E.1, this transportation analysis directly employs the use of public and crew *risk-per-shipment* values from the 2008 LANL SWEIS for the various primary radiological material forms (i.e., SNM, low-level radioactive waste [LLW], TRU waste) that would be shipped over the next 15 years. Specifically, the per-shipment values extracted from the 2008 LANL SWEIS were directly applied to the number of estimated shipments (and thus miles to be ultimately traversed) per material form to and from SNL/NM to attain conservative radiological health risk estimates (in terms of latent cancer fatalities [LCFs]) for both the public and truck crews. [Note that an explanation of human health effects and the terms used (e.g., LCF, rem, person-rem) are provided in Appendix D, Section D.2.]

Associated impact results from the assessment methodology described in Section E.3 are summarized in Table E-4, which provides total (i.e., cumulative) LCF estimates that could result during the SNL/NM SWEIS's 15-year analytical period (under all alternatives) for the public and crews from incident-free transport, as well as projected public LCF consequences from a hypothetical maximum reasonably foreseeable transportation accident.

E.3.5 Incident-Free Impact Analysis

For incident-free transportation, potential human health impacts from the radiation fields surrounding radioactive packages were estimated for transportation workers and populations along routes, people sharing the routes, and people at rest areas and stops along the routes. RADTRAN 5 (SNL 2000) was originally used in the development of estimated per-shipment impacts for transportation workers and populations for the 2008 LANL SWEIS, as well as the impact to an MEI (e.g., a person stuck in traffic, a gas station attendee, an inspector), who may be a worker or a member of the public. In general, material containers to be shipped offsite or to SNL/NM are expected to present low levels of radiation exposure to the public and truck crews. The radiological dose rates would be below the limiting provisions specified in 49 CFR 173.441 regarding transport indexes and exclusive-use shipments. For incident-free transportation, the potential radiological exposure of truck crews and the public would be directly related to the external dose rates associated with such material packages.

All incident-free radiological health impacts are expressed as additional LCFs. LCFs associated with radiological exposure were estimated by multiplying occupational (worker) and public doses by 0.0006 LCFs per rem (for individuals) or person-rem (for collective populations) of exposure (DOE 2003).

E.3.6 Accident Impact Analysis

Human health impacts can likewise (and potentially more severely) result from a transportation-related accident. The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident's probability (accident frequency) multiplied by the accident's consequences. The analysis of accident risks accounts for a spectrum of accidents, ranging from high-probability accidents of low severity (a fender bender) to hypothetical high-severity accidents that have a corresponding low probability of occurrence. Only as a result of a severe fire or a powerful collision, which both are of extremely low probability, could a transportation package of the type used to transport radioactive material be damaged to the extent that radioactivity could be released to the environment with potentially significant consequences. In concert with calculating the individual radiological risks that could result from all reasonably conceivable accidents during transportation of radioactive materials under the alternatives assessed in this SWEIS, DOE/NNSA placed particular emphasis upon the consequences of maximum reasonably foreseeable accidents with conditional probabilities greater than 0.0000001 (i.e., 1 in 10 million) per year. Such consequences were determined for atmospheric conditions that would likely prevail during accidents (NNSA 2023a).

Potential accident damage to a transport container/cask is categorized according to the magnitude of the mechanical forces (impact) and thermal forces (fire) to which it may be subjected during an accident. Because all accidents can be described in these terms, severity is independent of the specific accident sequence. In other words, any sequence of events that results in an accident in which a container/cask is subjected to forces within a certain range of values is assigned to the accident severity category associated with that range. Accident severity assignment schemes are designed to take into account all potential foreseeable transportation accidents, including accidents with low probability but high consequences and those with high probability but low consequences (as discussed previously in this section).

In essence, accident consequence assessments typically only consider the potential impacts of severe transportation accidents. In terms of risk, the severity of an accident must be viewed in terms of potential radiological consequences, which are directly proportional to the fraction of the radioactive material within a container/cask released to the environment during the accident. Although accident severity categories span the entire range of mechanical and thermal accident loads, they are conventionally grouped into “assessment bins” characterized by a single set of release fractions and are, therefore, collectively evaluated within an accident consequence assessment. Accident severity fractions thus account for the sum of all conditional probabilities that exist within a particular accident bin.

The SNL/NM SWEIS’s transportation accident risk assessment emphasizes the importance of distinguishing between the airborne release fraction (ARF) and respirable fraction of a released radioactive material in a scenario resulting from a transportation accident event. Radiological consequences are typically calculated by assigning radionuclide release fractions on the basis of the type of waste, the type of shipping container, and the accident severity category. The ARF is defined as the fraction of the radioactive material in the container that could be released to the atmosphere in a given severity of accident. ARFs vary according to the waste type and the physical or chemical properties of the radioisotopes. Most solid radionuclides are non-volatile and relatively non-dispersible. It is noteworthy to emphasize this is likely the case for the majority of material types/streams evaluated in this SWEIS. Respirable fractions, on the other hand, quantitatively represent an estimated percent of airborne radiological material taken up in the human body via the respiratory system. Potential public impacts from the *unmitigated maximum foreseeable accident event for this SWEIS* (involving the transport of powdered Pu metal [or possibly, the transport of Pu oxide powder]) to or from SNL/NM is estimated to be less than 4.3 rem (<0.003 LCF) to an MEI and less than 6,300 person-rem (<4 LCFs) to nearby populations (DOE 2015). The atmospheric environments assumed in the near-and far-field modeling for this event invoked both stable conditions (Class F with a windspeed of 1 meter per second [2.2 miles per hour]) and neutral conditions (Class D with a windspeed of 4 meters per second [8.8 miles per hour]). This approach provided suitable estimates of the potential dose to the MEI as well as nearby populations within a zone, respectively. The MEI was modeled under worst-case weather conditions (stable atmosphere, with minimum diffusion and dilution), while the population was modeled under average (i.e., neutral) weather conditions.

All projected radiological health impacts to potential receptors for this accident evaluation are expressed as additional transportation accident risks (in terms of LCFs) and were derived by multiplying occupational (worker) and public doses by 0.0006 LCFs per person-rem of exposure (DOE 2003).

For those accidents that do not result in damage to a material or waste container (or cask shielding) and no radioactive material or waste is released, it is assumed it would take 12 hours to recover from the accident and resume shipments. During this period, no individual would remain close to a container/cask. A first responder is conservatively assumed to stay at a location 2 to 10 meters (6.6 to 33 feet) from a container(s) for 1 hour (DOE 2002).

Conversely, for accidents that do entail a radiological release scenario, as mentioned in Section E.3.3, the estimation of resulting impacts to public populations from such an event

includes populations within 50 miles of the accident site as potential receptors and accordingly considers the following exposure pathways in the determination of said impacts:

- external exposure to the passing radioactive cloud (plume),
- external exposure to contaminated ground,
- internal exposure from inhalation of airborne contaminants, and
- internal exposure from the ingestion of contaminated food.

Although remedial activities after such an event (e.g., evacuation or ground cleanup) would reduce the overall consequences to the public, as a conservative measure for this analysis, these activities were generally not assumed to occur.

In general, SNL/NM has carefully examined onsite transfers of radioactive materials and has established engineered and administrative controls to minimize the impact and frequency of related potential accidents. SNL/NM site documents describe the envelopes within which onsite shipping operations must occur in order to regularly meet safety objectives. Such references/resources may include onsite hazardous materials packaging and transportation safety guides that address operational requirements for transfers of smaller quantities, while onsite nuclear material transportation safety guides, or the like, would prescribe the requirements for larger quantities. DOE Orders 461.2 (DOE 2010) and 460.2B (DOE 2022a) are the primary mechanisms that are followed at SNL/NM, which require implementing Transportation Safety Documents for both nuclear and non-nuclear onsite transfers. SNL/NM, in general, does not process, package, or move Type B nuclear materials for onsite or offsite transfers or shipments. SNL/NM's Transportation Safety Documents are conventionally designated as exclusively "Non-Nuclear." However, SNL/NM does maintain a legacy on-the-shelf "Nuclear" Transportation Safety Document that could potentially be implemented for future mission use, contingent upon a requisite update as well as a revised Safety Basis evaluation.

For determining non-radiological traffic accident fatalities from offsite commercial truck transportation, separate accident rates and accident fatality risks were used for rural, suburban, and urban population zones. Accident and fatality-rate reference information was taken from ANL/ESD/TM-150, *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999), with "mean" accident and fatality statistics broken down by "interstate," "primary," and "total" categorizations. Such values could then be assigned to assessed rural, suburban, and urban population zones, respectively. Accident "rates" are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with "accident involvement" depicting the numerator of the fraction and "vehicular activity" (i.e., total travel distance in truck-miles) as the denominator.

E.3.7 Intentional Destructive Acts

With regard to the topic of intentional destructive acts (also referred to as sabotage or terrorism), DOE/NNSA estimates that the potential consequences from such an assault on a shipment of radiological materials from/to SNL/NM would be expected to be bounded by the unmitigated consequences of the maximally reasonably foreseeable accident (i.e., "severe accident") discussed in Section E.3.6 (i.e., <4 LCFs to the general public). This is due to the notion that a

severe accident entails, by definition, the most extreme (yet plausible) mechanical (impact) and thermal (fire) forces (including from a truck-fuel-based explosion) being placed upon a subject container due to a roadway event.

E.3.8 Material and Waste Routing – Specific Locational Assumptions

For analysis purposes, this SWEIS identifies primary transportation locations (origination and/or destination) that would likely represent the vast majority of shipments made during the 15-year analytical period. In practice, SNL/NM would likely transport SNM and radioactive waste to other select locations as well; however, the designation of the primary analyzed locations within this SWEIS’s transportation analysis would be expected to adequately bound any such additional shipments to/from other hypothetical locations. Table E-1 details the primary shipping locations evaluated in this analysis:

- SNM and/or other nuclear materials shipped to other NNSA and DOE sites and to a potential commercial location;
- LLW/mixed low-level radioactive waste (MLLW) shipped to the Nevada National Security Site (NNSS) and any commercial facility accredited by the Department of Energy Consolidated Audit Program (DOECAP); and
- Small amounts of legacy or other TRU wastes shipped to the WIPP in New Mexico (DOE 2013; DOE 2015; DOE 2020a; NNSA 2008; NNSA 2023b).

Impacts from the periodic transportation of any other incidental radioactive materials (outside of the categories listed above) to other possible locations (DOE or commercial) across the United States would be expected to be represented and bounded by the overall estimates of presented health impacts from radiological transportation in this SWEIS.

Table E-1. Candidate Locations for Transport of Radiological Materials and Wastes to/from SNL/NM

Location	Route Distance to/from SNL/NM (mi)	LLW/ MLLW	TRU	SNM/Other Nuclear Materials
LANL, NM	100			X
LLNL, CA	1,050			X
INL, ID	830		X	X
NNSS, NV	675	X		X
PNNL, WA	1,240			X
WIPP, NM	300		X	X
Other	1,370 ^a	X ^b		X ^c

INL: Idaho National Laboratory; LLNL: Lawrence Livermore National Laboratory; PNNL: Pacific Northwest National Laboratory

a. Average shipping distance to the six candidate destinations.

b. Commercial facility accredited by DOECAP, such as Perma-Fix in Gainesville, Florida, and/or Diversified Scientific Services, Inc. (DSSI), in Kingston, Tennessee

c. Examples of potential material shipping locations include Savannah River Site in South Carolina; Oak Ridge National Laboratory and Y-12 National Security Complex in Tennessee; the Hanford Site in Washington State, Portsmouth Site in Ohio, and Gammatron Sealed Source Solutions, a DOECAP-accredited commercial facility in Texas. Only a very small quantity of shipments over the 15-year lifetime of the Alternatives is expected (about six shipments).

Table E-2 provides overall estimated numbers of waste shipments to/from each destination or origination location under each alternative over the 15-year analytical period for this SWEIS.

Table E-2. Estimated Numbers of Total Cumulative Shipments and Miles Driven for Radiological Wastes over Each Alternative’s Proposed Full 15-Year Duration (Inbound + Outbound)

Alternative	Radioactive Waste: LLW & MLLW^a (to NNSS / DOECAP- accredited commercial TSDF) Total Number of Shipments / (total miles driven)	Radioactive Waste: TRU^a (to WIPP) Total Number of Shipments / (total miles driven)	Non-Radiological Waste: Hazardous^a (to offsite treatment, storage, and disposal location) Total Number of Shipments / (total miles driven)
No-Action (2025–2040)	480 / (324,000)	15 / (4,500)	3,750 / (1,725,000)
Modernized Operations (2025–2040)	480 / (324,000)	20 / (6,000)	6,450 / (2,967,000)
Expanded Operations (2025–2040)	720 / (486,000)	80 / (24,000)	12,000 / (5,520,000)

a. Outbound only. The majority of the waste is legacy, with small quantities from various operations.

Table E-3 presents the overall estimated numbers of material shipments to/from each destination/origination location under each alternative over the 15-year analytical period for this SWEIS. In the left-most radioactive materials SNM column, it is assumed on average that 6 to 8 SNM shipments per year would be transported *from* LANL and/or Lawrence Livermore National Laboratory (LLNL) to SNL/NM (estimated at 5.5 average shipments per year *from* LANL and 1.5 average shipments per year *from* LLNL). These estimates include:

- 4 to 5 inbound shipments per year (1 to 2 experiments per shipment) of unirradiated Plutonium Isentropic Compression Experiment (Pu-ICE) target material from LANL,
- 1 additional SNM shipment from LANL that is unrelated to Pu-ICE research,
- 1 to 2 outbound shipments per year of unirradiated Pu-ICE (and possibly other unirradiated or irradiated material) transported back to LANL, and
- 1 to 2 SNM shipments to/from LLNL (including possibly Pu-ICE) that would undergo irradiation and evaluation at SNL/NM and then be returned to LLNL.

Instead of shipping directly back to LANL and/or LLNL, post-experiment unirradiated Pu-ICE SNM possibly could be first shipped (as SNM) from SNL/NM to Idaho National Laboratory (INL) and/or WIPP. The SNL/NM shipping of this SNM to INL and/or WIPP would be for testing and research to better effect waste management practices and to ultimately process the material into the TRU-waste form prior to its final disposition at WIPP. This possible approach is characterized in the second data column of Table E-3.

In the radioactive materials Annular Core Research Reactor (ACRR) SNM column in Table E-3, 80 shipments are estimated in both the Modernization and Expanded Operations Alternatives.

These 80 shipments are inclusively evaluated for both INL and/or Pacific Northwest National Laboratory (PNNL) as potential destinations. These radioactive materials (i.e., irradiated reactor fuel rods) could be processed (i.e., reloaded) at SNL/NM (with no shipments), or alternatively be sent to INL or PNNL for possible reloading, depending on whether future approval is obtained for either of these pathways. Furthermore, as characterized in the final column of Table E-3, up to 120 shipments of new/unirradiated reactor fuel may be procured and transported to SNL/NM from possible vendor locations reaching as far as the U.S. east or west coasts. Such new fuel shipments, however, would not be expected to contribute any measurable incident-free doses to the public or shipping crews while in transit.

Table E-3. Estimated Numbers of Total Cumulative Shipments and Miles Driven for Radiological Materials over Each Alternative's Proposed Full 15-Year Duration (Inbound + Outbound)

Alternative	Radioactive Materials: SNM ^a (to/from LANL and/or LLNL) Total Number of Shipments / (total miles driven)	Radioactive Materials: Pu-ICE SNM ^b (from SNL/NM to INL and/or WIPP) Total Number of Shipments / (total miles driven)	Radioactive Materials: "Other" SNM/Nuclear Materials ^c (from SNL/NM to listed locations in Table E-1) Total Number of Shipments / (total miles driven)	Radioactive Materials: ACRR SNM ^d (to/from INL and/or PNNL) Total Number of Shipments / (total miles driven)	Radioactive Materials: CREST SNM ^e (from potential east-coast vendor to SNL/NM) Total Number of Shipments / (total miles driven)
No-Action (2025–2040)	173 / (60,000)	--	--	--	--
Modernized Operations (2025–2040)	173 / (60,000)	120 / (36,000 [WIPP] and/or 99,600 [INL]; Avg = 67,800)	6 / (8,220)	80 / (66,400 [INL] and/or 99,200 [PNNL]; Avg = 82,800)	--
Expanded Operations (2025–2040)	173 / (60,000)	120 / (36,000 [WIPP] and/or 99,600 [INL]; Avg = 67,800)	6 / (8,220)	80 / (66,400 [INL] and/or 99,200 [PNNL]; Avg = 82,800)	120 / (240,000)

CREST: Combined Radiation Environments for Survivability Testing

- SNM shipments to/from SNL/NM to/from LANL/LLNL are typically comprised of Pu metal or Pu oxide (e.g., unirradiated targets); however, the possibility of other SNM source-material (e.g., highly enriched uranium, uranium-233, or other highly fissionable nuclear materials) being shipped between the laboratories for this case cannot be ruled out.
- In lieu of shipping directly back to LANL and/or LLNL, post-experiment unirradiated Pu-ICE could potentially first be shipped (as SNM) from SNL/NM to INL and/or WIPP for testing/processing, and then ultimately for disposition at WIPP (as TRU waste), if a pathway is ultimately approved for such cases. These mileage estimates collectively bound (i.e., exceed) the total expected cumulative mileage that would be driven if the Pu-ICE were instead just shipped directly back to LANL and LLNL, particularly since most of the Pu-ICE shipments would be associated with LANL, which is only a 100-mile drive from SNL/NM. Although the possibility may exist for some degree of mileage double-counting between this column and the first column (for direct LANL & LLNL shipments), as a conservative approach, both transportation cases are fully assumed within the tabulation of impacts in Section E.4.
- Small quantities of "other" SNM or nuclear materials may be sporadically shipped from SNL/NM to various NNSA sites, DOE sites, and/or a potential commercial entity (as listed in Table E-1) with one shipment estimated to occur every 2.5 years on average within a 15-year period (for a grand total of 6 shipments). These shipments, however, could potentially occur at any time during the 15-year period.
- It is possible that additional SNM shipments may occur to support future ACRR irradiated fuel reloading efforts; a total of 80 associated shipments are projected as a bounding estimate over the 15-year period. This fuel, however, could ultimately stay at SNL/NM for a portion of or the entirety of the reloading timeline.

(i.e., be partially or fully performed onsite), or potentially be shipped to INL and/or PNNL for recladding (partially or fully), depending on approval pathways.

- e. It is proposed that new reactor fuel (considered SNM) shipments would occur to support CREST; a total of 120 associated shipments are projected as a bounding estimate over the 15-year period. Accordingly, a bounding estimated distance of 2,000 miles per shipment is assumed for this case. However, it is key to emphasize that such fresh/unirradiated fuel would not be highly radioactive and would not pose any discernible additional radiological health risks to the public or shipping-crews during transport; as such, no contributions from this category are included in the projected dose rollups provided in Section E.4.

E.4 IMPACTS

E.4.1 Radiological and Non-Radiological Transportation Impacts

Table E-4 summarizes the estimated total transportation impacts associated with each of the three alternatives. E.3.8 The maximum total dose to the public under any/all of the alternatives would be about 17.7 person-rem from all incident-free shipments over the 15-year Expanded Operations Alternative. The expected additional LCFs that could be expected among the associated exposed populations would be about 0.011. With regard to a potential annual bounding dose to a hypothetical public MEI from incident-free transportation at any point along a route, a dose of 0.00018 rem/year is estimated, with an associated increased risk of an LCF to that individual of 0.00000011/year (NNSA 2023a).

The maximum total dose to transportation crews (truck drivers) would be 18.1 person-rem from all incident-free shipments over the 15-year Expanded Operations Alternative period, with an associated 0.011 additional LCFs among the exposed crews. Because the potential for a trained radiation worker truck-crew member to develop a fatal latent cancer from a maximum allowable annual exposure is 0.0012, an individual worker would thus not be expected to develop a lifetime fatal latent cancer even from a continual 15-year maximum allowable annual exposure associated with these activities (0.018 LCF total). A maximally exposed inspector would be expected to receive 19 millirem per hour of inspection duty performed and would likewise be limited to the subject 2 rem/year administrative annual dose limit (DOE 2017 and SNL 2000).

Table E-4 also presents the annual risk of traffic accident fatalities for each of the alternatives. In all cases, under all alternatives, the annualized risk of a traffic accident direct fatality is greater than the annualized risk of an additional LCF due to potential radiological exposure from an accident. For example, the annualized LCF risk among exposed populations from an accident occurring during LLW/MLLW shipments to NNS or a DOE/CAP-accredited commercial facility over the Expanded Operations Alternative period would be 0.00000082, while the estimated annualized number of traffic accident fatalities associated with these shipments over the period would be 0.0015 (a factor of about 1,800 higher).

**Table E-4. Estimated Impacts of Transporting Radioactive Materials and Wastes
Over Each Alternative's Proposed 15-Year Duration for Maximum Distance Traveled**

Alternative/ Transport Segments	Offsite Destination or Origination	Radiological Material (estimated peak number of shipments)	Segment Distance	Incident-Free ^a Crew Total Dose (person-rem)	Incident-Free ^a Crew Total Risk (LCFs)	Incident-Free ^a Population Total Dose (person-rem)	Incident-Free ^a Population Total Risk (LCFs)	Accident ^a Annualized Radiological Risk (LCFs/yr)	Accident ^a Non- Radiological Risk (# of traffic- accident fatalities/yr)
<i>No-Action – 15 years of shipping</i> SNL/NM to/from LANL	LANL	SNM (128)	100	0.039	2.3×10^{-5}	0.044	2.6×10^{-5}	2.7×10^{-10}	$1.1 \times 10^{-5}{}^b$
<i>No-Action – 15 years of shipping</i> SNL/NM to/from LLNL	LLNL	SNM (45)	1,050	0.14	8.4×10^{-5}	0.16	9.5×10^{-5}	9.6×10^{-10}	$3.9 \times 10^{-5}{}^b$
<i>No-Action – 15 years of shipping</i> SNL/NM to NNSS	NNSS ^c	LLW/MLLW (480)	675	5.7	3.4×10^{-3}	2.2	1.3×10^{-3}	5.4×10^{-7}	6.9×10^{-4}
<i>No-Action – 15 years of shipping</i> SNL/NM to WIPP	WIPP	TRU (15)	300	0.30	1.8×10^{-4}	0.096	5.8×10^{-5}	2.9×10^{-11}	1.3×10^{-5}
TOTAL	--	--	--	6.18	3.7×10^{-3}	2.50	1.5×10^{-3}	5.4×10^{-7}	7.5×10^{-4}
<i>Modernized Operations – 15 years of shipping</i> SNL/NM to/from LANL	LANL	SNM (128)	100	0.039	2.3×10^{-5}	0.044	2.6×10^{-5}	2.7×10^{-10}	$1.1 \times 10^{-5}{}^b$

Alternative/ Transport Segments	Offsite Destination or Origination	Radiological Material (estimated peak number of shipments)	Segment Distance	Incident-Free ^a Crew Total Dose (person-rem)	Incident-Free ^a Crew Total Risk (LCFs)	Incident-Free ^a Population Total Dose (person-rem)	Incident-Free ^a Population Total Risk (LCFs)	Accident ^a Annualized Radiological Risk (LCFs/yr)	Accident ^a Non- Radiological Risk (# of traffic- accident fatalities/yr)
Modernized Operations – 15 years of shipping SNL/NM to/from LLNL	LLNL	SNM (45)	1,050	0.14	8.4×10^{-5}	0.16	9.5×10^{-5}	9.6×10^{-10}	$3.9 \times 10^{-5}{}^b$
Modernized Operations – 15 years of shipping SNL/NM to INL and/or WIPP	INL/WIPP	SNM (120)	565 (avg)	0.20	1.2×10^{-4}	0.23	1.4×10^{-4}	1.4×10^{-9}	$5.6 \times 10^{-5}{}^b$
Modernized Operations – 15 years of shipping SNL/NM to “other” 6 candidate NNSA/DOE/Commec ial locations	Various	SNM or other Nuclear Material (6)	1,370 (avg)	0.024	1.5×10^{-5}	0.028	1.7×10^{-5}	1.7×10^{-10}	$6.8 \times 10^{-6}{}^b$
Modernized Operations – 15 years of shipping SNL/NM to/from INL and/or PNNL	INL/PNNL	SNM (irradiated fuel) (80)	1,035 (avg)	7.5	4.5×10^{-3}	13.4	8.0×10^{-3}	2.8×10^{-9}	$2.8 \times 10^{-4}{}^b$

Alternative/ Transport Segments	Offsite Destination or Origination	Radiological Material (estimated peak number of shipments)	Segment Distance	Incident-Free ^a Crew Total Dose (person-rem)	Incident-Free ^a Crew Total Risk (LCFs)	Incident-Free ^a Population Total Dose (person-rem)	Incident-Free ^a Population Total Risk (LCFs)	Accident ^a Annualized Radiological Risk (LCFs/yr)	Accident ^a Non- Radiological Risk (# of traffic- accident fatalities/yr)
Modernized Operations – 15 years of shipping SNL/NM to NNSS	NNSS ^c	LLW/MLLW (480)	675	5.7	3.4×10^{-3}	2.2	1.3×10^{-3}	5.4×10^{-7}	6.9×10^{-4}
Modernized Operations – 15 years of shipping SNL/NM to WIPP	WIPP	TRU (20)	300	0.40	2.4×10^{-4}	0.13	7.7×10^{-5}	3.9×10^{-11}	1.7×10^{-5}
TOTAL^d	--	--	--	14.0	8.4×10^{-3}	16.2	9.7×10^{-3}	5.5×10^{-7}	1.1×10^{-3}
Expanded Operations – 15 years of shipping SNL/NM to/from LANL	LANL	SNM (128)	100	0.039	2.3×10^{-5}	0.044	2.6×10^{-5}	2.7×10^{-10}	1.1×10^{-5} ^b
Expanded Operations – 15 years of shipping SNL/NM to/from LLNL	LLNL	SNM (45)	1,050	0.14	8.4×10^{-5}	0.16	9.5×10^{-5}	9.6×10^{-10}	3.9×10^{-5} ^b
Expanded Operations – 15 years of shipping SNL/NM to INL and/or WIPP	INL/WIPP	SNM (120)	565 (avg)	0.20	1.2×10^{-4}	0.23	1.4×10^{-4}	1.4×10^{-9}	5.6×10^{-5} ^b

Alternative/ Transport Segments	Offsite Destination or Origination	Radiological Material (estimated peak number of shipments)	Segment Distance	Incident-Free ^a Crew Total Dose (person-rem)	Incident-Free ^a Crew Total Risk (LCFs)	Incident-Free ^a Population Total Dose (person-rem)	Incident-Free ^a Population Total Risk (LCFs)	Accident ^a Annualized Radiological Risk (LCFs/yr)	Accident ^a Non- Radiological Risk (# of traffic- accident fatalities/yr)
Expanded Operations – 15 years of shipping SNL/NM to “other” 6 candidate NNSA/DOE/Private locations	Various	SNM or other Nuclear Material (6)	1,370 (avg)	0.024	1.5×10^{-5}	0.028	1.7×10^{-5}	1.7×10^{-10}	$6.8 \times 10^{-6}{}^b$
Expanded Operations – 15 years of shipping SNL/NM to/from INL and/or PNNL	INL/PNNL	SNM (irradiated fuel) (80)	1,035 (avg)	7.5	4.5×10^{-3}	13.4	8.0×10^{-3}	2.8×10^{-9}	$2.8 \times 10^{-4}{}^b$
Expanded Operations – 15 years of shipping SNL/NM to NNSS	NNSS ^c	LLW/MLLW (720)	675	8.6	5.2×10^{-3}	3.3	2.0×10^{-3}	8.1×10^{-7}	1.0×10^{-3}
Expanded Operations – 15 years of shipping SNL/NM to WIPP	WIPP	TRU (80)	300	1.6	9.6×10^{-4}	0.51	3.0×10^{-4}	1.6×10^{-10}	6.7×10^{-5}
TOTAL^d	--	--	--	18.1	0.011	17.7	0.011	8.2×10^{-7}	1.5×10^{-3}

- a. Cumulative risks from shipments over the entire action period (15 years for all alternatives) are shown for incident-free transportation; annualized risks over the action periods are presented for accidents.
- b. Includes additional traffic-accident risks associated with two potential escort vehicles accompanying each shipment of SNM.
- c. All LLW/MLLW shipment impacts are conservatively and consistently evaluated by assuming such materials are exclusively transported to NNSS, although shipments can be transported to a DOECAP-accredited commercial facility.

- d. Collective totals under the Modernized and Expanded Operations Alternatives conservatively acknowledge the possibility that some legacy nuclear material (including Pu-ICE as well as other potential SNM) ultimately destined for disposal as TRU waste at the WIPP may initially be transported to INL or WIPP for research/testing, characterization, waste reduction, and/or recycling, prior to being sent to the WIPP for final disposition. Moreover, the totals also conservatively acknowledge (and subsume) the possibility that ACRR-related SNM (irradiated fuel) may be transported to/from INL and/or PNNL for potential recladding activities as opposed to being strictly performed onsite at SNL/NM.

NOTES: Scientific notation is used to simplify the presentation; as a clarifying example, 6.2×10^{-3} is the same as 0.0062, or one chance of an LCF in 161 years. Presented impact values throughout the table may be subject to slight deviations from calculated values due to rounding.

E.4.2 Onsite Traffic and Parking Capacity Impacts

The baseline Existing Environment (current conditions) for traffic within the region of influence (refer to Chapter 4, Table 4-1) is presented in Chapter 4, Section 4.11, of this SWEIS. Table E-5 displays/compares how projected employment increases at SNL/NM under the No-Action, Modernized Operations, and Expanded Operations Alternatives could potentially impact nearby area roads adjacent to the primary gate locations for KAFB and SNL/NM. As shown in the table, compared to current conditions, potential maximum increases in average daily traffic (ADT) volumes along such road segments would be expected to mirror SNL/NM's employee growth (operations and construction) estimates. Although these increases would add to the already existing periodic congestion common to these road segments, they would not be expected to change their current level of service designations. If all additional workers were to enter and exit the site through the Eubank Gate, this could hypothetically be enough to exacerbate traffic and ultimately change the LOS designation on/along Eubank Boulevard. Since many factors besides volume affect how a given traffic change would affect the LOS on a given road, the ability to make definitive conclusions about an LOS change on a given road is limited. The presented estimates conservatively assume that all additional workers would (1) exclusively commute to work alone in personal vehicles and would follow the same route to and from the site, and (2) not be telecommuting/remote working in any capacity at any time.

Potential localized impacts resulting from postulated changes to area traffic flows in the years ahead, as depicted in Table E-5, resulted in the following conclusions:

- (1) Local traffic flows around SNL/NM (and onsite parking demand) would be expected to moderately increase above current levels under the No-Action Alternative because employment levels would see an increase over current levels under this alternative.
- (2) A further increase (beyond that seen under the No-Action Alternative) in traffic around SNL/NM (and onsite parking demand) would be expected due to further additional projected increases in employment under the Modernized Operations Alternative.
- (3) A further increase (beyond that seen under the Modernized Operations Alternative) in traffic around SNL/NM (and onsite parking demand) would be expected due to further additional projected increases in employment under the Expanded Operations Alternative.
- (4) Under all alternatives, there would be periods with higher levels of construction that would result in increased traffic congestion and parking needs during those times, although these periods would be expected to be limited and would vary across the site.

Of note, if the site's remote-work/telecommuting policies continue at present levels (refer to Chapter 4, Section 4.11, of this SWEIS), up to 20 percent of the SNL/NM operations workforce could hypothetically be teleworking during any given workday. Over the course of each week/year under any of the three alternatives, this option would mitigate (i.e., offset) potential increases in ADT volumes (from projected workforce growth) along SNL/NM's nearby access corridors.

Table E-5. Comparison of Changes in Potential SNL/NM-Workforce Traffic Flows at Area Roads Among All Alternatives

Access Route	Present Baseline ADT Volume (vehicles/day) ^a	Projected No- Action Alternative ADT Volume (vehicles/day) ^b	Projected Modernized Operations Alternative ADT Volume (vehicles/day) ^b	Projected Expanded Operations Alternative ADT Volume (vehicles/day) ^b
Intersection of Eubank Blvd and Innovation Parkway (Eubank Gate area)	22,279	22,324	22,790	23,503
Intersection of Wyoming Blvd and Susan Ave (Wyoming Gate area)	7,034	7,048	7,195	7,421
Intersection of Gibson Blvd and Louisiana Blvd (Gibson Gate area)	17,062	17,096	17,453	17,999
Intersection of Gibson Blvd and San Mateo Blvd (Truman Gate area)	53,210	53,317	54,429	56,134
TOTALS	99,585	99,785	101,867	105,057

a. Source: NMDOT 2024

b. Assumes that (1) future traffic would be distributed across area roads in the same percentages as existing traffic, (2) each additional worker would commute to the SNL/NM site alone daily and would follow the same route to and from SNL/NM, and (3) conservatively assumes all SNL/NM operational employees commute round-trip daily, with no remote working or telecommuting.

E.5 UNCERTAINTIES AND CONSERVATISMS IN ESTIMATED IMPACTS

The sequence of analysis usually performed to generate estimates of radiological risk for transportation endeavors typically includes the following items: (1) determination of material inventories and characteristics, (2) estimations of shipment requirements, (3) determinations of route characteristics, (4) calculations of radiation doses to exposed individuals (including estimation of environmental transport and uptake of radionuclides), and (5) estimations of associated health effects (LCFs). Uncertainties, however, are inherently associated with each of these steps. Uncertainties exist in the way that the physical systems being analyzed are essentially represented/depicted by the computational models used for characterizing them; either by the data required to exercise such models (due to measurement errors, sampling errors, natural variability, or unknowns caused simply because the actions being analyzed are in the future), or within the calculations themselves (e.g., algorithm approximations used within the computer codes, rounding errors).

In principle, one can estimate the uncertainty associated with each input or computational source and predict the resultant uncertainty in each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final, or absolute, result. However, conducting such a full-scale quantitative uncertainty analysis is often impractical and sometimes impossible, especially for actions to be initiated at an unspecified time in the future. Instead, transportation risk analysis was designed to ensure, through uniform, judicious, and conservative selection of scenarios, models, and input parameters, that relative

comparisons of risk among candidate alternatives are meaningful. Within a specific transportation risk assessment, this design is accomplished by uniformly applying common input parameters and assumptions to all evaluated alternatives. Therefore, although considerable uncertainty is inherent in the absolute magnitude of the transportation risk for each alternative, much less uncertainty is associated with the relative differences between the alternatives in a given measure of risk (DOE 2002).

As such, the following sections briefly discuss typical areas of uncertainty that are addressed within each of the assessment steps listed in the first paragraph of this section. Special emphasis is placed on identifying whether the uncertainties affect relative or absolute measures of risk. Moreover, the reality and conservatism of the assumptions are addressed, and where practical, the parameters that most significantly affect the overall risk assessment results are identified.

E.5.1 Uncertainties in Material Inventories and Characterization

Material inventories and their physical and radiological characteristics are important input parameters to a transportation risk assessment. The potential numbers of shipments under each considered alternative are primarily based on the projected dimensions of package contents, radiation-field strength/intensity, and assumptions concerning shipment capacities. Physical and radiological characteristics are important in determining the amount and nature of material released during accidents and the subsequent doses to exposed individuals through multiple environmental exposure pathways.

Uncertainties in material inventories and characterization are directly reflected in transportation risk results. If an inventory is overestimated (or underestimated), the resulting transportation risk estimates are also overestimated (or underestimated) by roughly the same factor. However, the same inventory estimates (on a per-unit basis) are used to analyze shipping impacts under each of the alternatives; therefore, for comparative purposes, the observed differences in transportation risks among alternatives are believed to represent unbiased, reasonably accurate estimates based on the most current assessment information available. DOE/NNSA has used historical shipment inventories for nuclear materials and radiological waste to provide a realistic estimate of inventories and their characterization. Considering that the analysis uses unit risk factors from the 2008 LANL SWEIS, such inventories (and their associated characteristics) would be expected to remain consistent with materials likely to be shipped during continued operations of SNL/NM.

E.5.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments

The extent of transportation required under each alternative is based in part on assumptions concerning the packaging characteristics and shipment capacities for transport vehicles. Representative shipment capacities have been defined for assessment purposes based on probable future shipment capacities. The actual shipment capacities may differ from the predicted capacities such that the projected number of shipments and, consequently, the total transportation risk would change. However, although the predicted transportation risks would increase or decrease accordingly, the relative differences in risks among the alternatives would remain about the same (DOT 2008).

DOE/NNSA has used a best-estimate projection of potential shipment numbers for each alternative to provide a realistic expectation of potential impacts as opposed to a bounding projection that would grossly overestimate potential results.

E.5.3 Uncertainties in Route Determinations

TRAGIS-analyzed routes (NNSA 2008) were initially determined between most likely origin and destination locations from which per-shipment dose/risk factors (per shipment material type) were evaluated for this SNL/NM SWEIS's projected numbers of shipments under each of the alternatives. The routes were determined to be consistent with current guidelines, regulations, and practices, but nevertheless they may not end up being the actual routes used for a number of future shipments. As such, notable differences in shipping-miles and nearby populations along route lines could potentially occur. Because materials could be transported over an extended period starting at some time in the future, highway infrastructure and core demographics along routes could likewise change from those originally anticipated. Although these effects have not been accounted for in this analysis via any type of sensitivity study, it is not anticipated that such changes would significantly affect relative comparisons of risk among the alternatives considered in this SWEIS.

E.5.4 Uncertainties in the Calculation of Radiation Doses

The models originally used to calculate radiation doses from transportation activities introduce uncertainty in the risk assessment process. Estimating the accuracy or absolute uncertainty of the risk assessment results is generally difficult. The accuracy of the calculated results is closely related to the limitations of the computational models and to the uncertainties in each of the input parameters that the model requires. The single greatest limitation facing users of RADTRAN, or any computer code of this type, is the limitation of data for certain input parameters. Populations along the transportation routes, shipment surface dose rates, and number of individuals residing near anticipated routes are the most uncertain data points in shipping dose calculations. In preparing these data, the analysis assumes that potentially affected populations are uniformly distributed and are proportional to traffic density, with an assumed occupancy of two persons per car; that the shipment surface dose rate is the maximum allowable dose rate per DOT standards; and that the potential exists for an individual to reside at the edge of a highway. Not all assumptions are accurate nor would be realized during the continuity of an entire 15-year period. For example, off-link (i.e., off the direct route) populations are predominantly heterogeneous, and on-link (i.e., on/along the direct route) traffic densities typically vary widely within a geographic zone (i.e., urban, suburban, or rural). Finally, added to this complexity are the assumptions regarding the expected distances between the public and the shipment at a traffic stop, rest stop, or during stalled traffic, and the afforded degree of shielding that may be available (but not credited) at such times.

Uncertainties associated with the computational models are reduced by using state-of-the-art computer codes that have undergone extensive review. Because many uncertainties are recognized but difficult to quantify, assumptions are made at each step of the risk assessment process that are intended to ultimately produce conservative results (i.e., overestimations of calculated dose and radiological risk). Because conservative parameters and bounding assumptions were applied consistently to each alternative in this transportation analysis

whenever possible, such model bias is not expected to affect the meaningfulness of relative comparisons of risk; however, it should be expected that final results may not represent risks in an absolute sense.

E.5.5 Uncertainties in Traffic Fatality Rates

Future accident and fatality rate data may change as a result of vehicle and highway improvements.

E.6 OFF-SITE EXPLOSIVES TRANSPORTATION

With regard to the potential transportation of any materials that may contain varying amounts of explosives, associated DOE/NNSA protocols and guidance to prevent or mitigate potential impacts to shipment crews and/or the public are provided in DOE Order 460.2B; DOE Order 460.1D, Change 1, *Hazardous Materials Packaging and Transportation Safety* (DOE 2022c); DOE Order 452.2F, *Nuclear Explosive Safety* (DOE 2020b); and DOE Order 440.1B, Change 4, *Worker Protection Program for DOE Federal Employees* (DOE 2022d). In these documents, DOE/NNSA specifies that before transporting explosive substances or articles fabricated by DOE (or alternatively under the direction or supervision of DOE), the originating DOE organization must test the materials and submit final hazard classification to NNSA's Office of Packaging and Transportation. NNSA provides concurrence with final hazard classification and copies of the supporting documentation for registration with DOT. Prior to testing, the originating DOE organization can request an interim hazard classification or ship via special permit. Interim hazard classifications are valid for a period of 1 year, are approved by NNSA's Office of Packaging and Transportation, and may be reissued upon expiration. Explosive materials may also be shipped by DOT Special Permits if the parameters are met. In addition, the following key criteria related to explosives are furthermore mandated (NNSA 2023a):

- Only qualified explosives handlers shall load and unload explosives aboard transport vehicles.
- Explosives shipped on common carriers shall be packaged, labeled, and shipped in accordance with DOT regulations.
- Items containing explosives transported by special agents in DOE-approved secure transporters are specifically governed by DOE Orders 452.2F and 460.1D, Change 1.
- Section 161.K of AEA and Title 18 U.S.C., Chapter 40, Section 845, govern security and emergency vehicles carrying explosives in support of approved contingency plans.
- The cargo on partly or completely loaded vehicles (including flatbed types) shall be blocked, braced, chocked, tied down, or otherwise secured to prevent shifting during transit.
- No explosives shall be loaded or unloaded from a transportation vehicle while the motor is running unless the motor is required to provide power to vehicle accessories used in loading and unloading operations and is moreover equipped with an exhaust spark arrestor.

- DOT regulations govern commercial transport vehicle shipments on public highways. Shipments from a DOE installation that meet the DOT definition of “in commerce” must fully comply with the applicable portions of DOT regulations, and with state and municipal regulations.
- A qualified inspector shall inspect and approve for compliance with an approved checklist any transport vehicle that may be loaded with explosives and is designated for movement over public highways. After loading, the cargo shall be inspected and approved, which includes verification of proper labeling/placarding.
- Before transport vehicles loaded with explosive materials leave a DOE facility, drivers shall be informed of the nature of their cargo and appropriate measures to take if the vehicle or load becomes involved in a fire.
- Drivers of explosive-laden vehicles shall meet the pertinent requirements of 49 CFR Parts 390–397. Moreover, such drivers shall be provided special training that emphasizes caution, road courtesy, and defensive driving. Drivers shall also have proper training in general safety precautions for explosives handling.
- Explosive-laden vehicles shall avoid congested areas whenever possible and shall stop at all railroad crossings.
- No personnel shall ride in the cargo area. Loose items (e.g., handling gear) in the cargo compartments are prohibited.
- No smoking is allowed in or within 25 feet of any vehicle containing explosives. Matches, lighters, or other fire-, flame-, or spark-producing devices shall not be in the vehicle or carried by personnel in the vehicle.
- The vehicle shall be subjected to regular maintenance checks.
- Other than when opened for inspection, containers of explosives shall not be opened or repaired on any transportation vehicle.
- Except for emergency situations, fueling or maintenance of vehicles containing explosives is forbidden.

E.7 REFERENCES

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APPENDIX F
CONTRACTOR DISCLOSURE FORMS

**NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE SITE-WIDE
ENVIRONMENTAL IMPACT STATEMENT FOR THE CONTINUED OPERATION OF
SANDIA NATIONAL LABORATORIES/NEW MEXICO**

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term “financial interest or other interest in the outcome of the project” for purposes of this disclosure is defined in the March 23, 1981 guidance “Forty Most Asked Questions Concerning CEQ’s National Environmental Policy Act Regulations,” 46 FR 8026-18038 at Question 17a and b.

“Financial or other interest in the outcome of the project” includes “any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm’s other clients).” 46 FR 18026-18038 at 18031.

In accordance with these requirements, the offeror and any proposed subcontractors hereby certify as follows: (check either (a) or (b) to assure consideration of your proposal).

- (a) X Offeror and any proposed subcontractor have no financial or other interest in the outcome of the project.
- (b) Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests

- 1.
- 2.
- 3.

Certified by



Signature

Abe Zeitoun, Senior Vice President
Printed Name and Title

SC&A, Inc..
Company

01/17/2024
Date

**NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE SITE-WIDE
ENVIRONMENTAL IMPACT STATEMENT FOR THE CONTINUED OPERATION OF
SANDIA NATIONAL LABORATORIES/NEW MEXICO**

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- (b) Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests

- 1.
- 2.
- 3.

Certified by



Signature

Maher Itani, Vice President
Printed Name and Title

Tetra Tech, Inc.
Company

January 19, 2024
Date

NEPA DISCLOSURE STATEMENT FOR PREPARATION OF THE *SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT FOR THE CONTINUED OPERATION OF SANDIA NATIONAL LABORATORIES/NEW MEXICO*

CEQ Regulations at 40 CFR 1506.5(c), which have been adopted by the DOE (10 CFR 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term “financial interest or other interest in the outcome of the project” for purposes of this disclosure is defined in the March 23, 1981 guidance “Forty Most Asked Questions Concerning CEQ’s National Environmental Policy Act Regulations,” 46 FR 8026-18038 at Question 17a and b.

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- (b) Offeror and any proposed subcontractor have the following financial or other interest in the outcome of the project and hereby agree to divest themselves of such interest prior to award of this contract.

Financial or Other Interests

- 1.
- 2.
- 3.

Certified by

Joseph Rivers
Signature

Joseph W. Rivers, Jr., President
Printed Name and Title

Rivers Consulting, Inc.
Company

January 19, 2024
Date

APPENDIX G
PUBLIC NOTICES



public notice of this meeting be announced in the **Federal Register**.

DATES: Wednesday, May 17, 2023; 1:00 p.m. to 5:00 p.m. MDT

ADDRESSES: This hybrid meeting will be open to the public in person and via WebEx. To attend virtually, please contact the Northern New Mexico Citizens Advisory Board (NNMCAB) Executive Director (below) no later than 5:00 p.m. MDT on Friday, May 12, 2023.

Board members, Department of Energy (DOE) representatives, agency liaisons, and Board support staff will participate in-person, following COVID-19 precautionary measures, at: Fuller Lodge Art Center, 2132 Central Avenue, Los Alamos, NM 87544.

Attendees should check with the NNMCAB Executive Director (below) for any meeting format changes due to COVID-19 protocols.

FOR FURTHER INFORMATION CONTACT: Menice B. Santistevan, NNMCAB Executive Director, by Phone: (505) 699-0631 or Email:

menice.santistevan@em.doe.gov.

SUPPLEMENTARY INFORMATION:

Purpose of the Board: The purpose of the Board is to make recommendations to DOE-EM and site management in the areas of environmental restoration, waste management, and related activities.

Tentative Agenda

- DOE Environmental Management Presentation
- Agency Updates

Public Participation: The in-person/online virtual hybrid meeting is open to the public in person or virtually, via WebEx. Written statements may be filed with the Board no later than 5:00 p.m. MDT on Friday, May 12, 2023, or within seven days after the meeting by sending them to the NNMCAB Executive Director at the aforementioned email address. Written public comments received prior to the meeting will be read into the record. The Deputy Designated Federal Officer is empowered to conduct the meeting in a fashion that will facilitate the orderly conduct of business. Individuals wishing to submit public comments should follow as directed above.

Minutes: Minutes will be available by emailing or calling Menice Santistevan, NNMCAB Executive Director, at menice.santistevan@em.doe.gov or at (505) 699-0631.

Signed in Washington, DC, on April 17, 2023.

La'Tanya Butler,

Deputy Committee Management Officer.

[FR Doc. 2023-08460 Filed 4-20-23; 8:45 am]

BILLING CODE 9450-01-P

DEPARTMENT OF ENERGY

National Nuclear Security Administration; Notice of Intent To Prepare a Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico

AGENCY: National Nuclear Security Administration, Department of Energy.
ACTION: Notice of intent.

SUMMARY: The National Nuclear Security Administration (NNSA), a semi-autonomous agency within the United States (U.S.) Department of Energy (DOE), announces its intent to prepare a new Site-Wide Environmental Impact Statement (SWEIS) for the Continued Operation of Sandia National Laboratories, New Mexico (SNL/NM SWEIS; DOE/EIS-0556). NNSA will prepare the SNL/NM SWEIS in accordance with the National Environmental Policy Act of 1969 (NEPA), and the Council on Environmental Quality (CEQ) and DOE regulations implementing NEPA. The SNL/NM SWEIS will analyze the potential environmental impacts of the reasonable alternatives for continuing operations of SNL/NM for approximately the next 15 years. While SNL has operations outside of New Mexico, the SNL/NM SWEIS is limited to activities at SNL/NM within the Kirtland Air Force Base (KAFB) and the Albuquerque area. The purpose of this Notice is to encourage public participation in the SNL/NM SWEIS process and to invite comments on the scope of analysis, including the range of alternatives, associated actions, and environmental issues that should be considered in the SNL/NM SWEIS. Following completion of the SNL/NM SWEIS, NNSA will issue a Record of Decision (ROD) announcing any decisions associated with the SNL/NM SWEIS.

DATES: NNSA invites federal agencies, tribes, state and local governments, industry, organizations, public interest groups, local businesses, and members of the general public to submit comments on the scope of the SNL/NM SWEIS through June 5, 2023 (the Comment Period). NNSA will consider all comments on the scope of the SNL/NM SWEIS received or postmarked during the Comment Period. Comments received or postmarked after the Comment Period ends will be considered to the extent practicable. NNSA will accept public comments on the proposed scope of the SNL/NM SWEIS in written and verbal form, and it will give equal weight to comments

provided by either method. NNSA will conduct two public scoping meetings at which verbal comments may be provided, including one in-person meeting with a virtual link for listen-in only and one virtual meeting, scheduled as follows:

- **In-person Meeting:** Tuesday, May 9, 2023; 6:30–8:50 p.m., Mountain Daylight Time, preceded by a poster session starting at 5:30 p.m., at the New Mexico Veterans Memorial, Museum & Conference Center, 1100 Louisiana Blvd. SE, Albuquerque, NM 87108. Listen-in for May 9: <https://www.zoomgov.com/j/1618755753>, toll-free 833-568-8864, Meeting ID: 161 875 5753.

- **Virtual Meeting:** Thursday, May 11, 2023; 6:30–8:50 p.m., Mountain Daylight Time, Listen-in and Participation for May 11: <https://www.zoomgov.com/j/1608652437>, toll-free 833-568-8864, Meeting ID: 160 865 2437.

- Further information about the public scoping meetings, including any changes in dates, places, or times, will be posted on the NNSA NEPA Reading Room website at: <https://www.energy.gov/nnsa/nnsa-nepa-reading-room>.

ADDRESSES: Written comments on the scope of the SNL/NM SWEIS or requests for information related to the SNL/NM SWEIS may be sent via postal mail to SNL/NM SWEIS Comments, National Nuclear Security Administration, Sandia Field Office, P.O. Box 5400, Albuquerque, NM 87185, or by email to: SNL-SWEIS@nnsa.doe.gov. Before including your address, phone number, email address, or other personally identifiable information in your comment, please be advised that your entire comment—including your personally identifiable information—might be made publicly available. If you wish for NNSA to withhold your name and/or other personally identifiable information, please state this prominently at the beginning of your comment. You may submit comments anonymously.

FOR FURTHER INFORMATION CONTACT: For further information about this Notice, please contact Dr. Adria Bodour, NEPA Compliance Officer, Sandia Field Office, by postal mail at National Nuclear Security Administration, Sandia Field Office, P.O. Box 5400, Albuquerque, NM 87185, by phone (505) 845-6314, or by email at SNL-SWEIS@nnsa.doe.gov or adria.bodour@nnsa.doe.gov. This Notice, related NEPA documents, and additional information about the NEPA process are available on the NNSA NEPA Reading Room website at: <https://www.energy.gov/nnsa/nnsa-nepa-reading-room>.

24608

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www.energy.gov/nnsa/nnsa-nepa-reading-room. Information will also be posted on the SNL/NM website at: <https://www.sandia.gov/about/environment>.

SUPPLEMENTARY INFORMATION:

Background

SNL/NM is managed and operated as a Federally Funded Research and Development Center (FFRDC), as defined in Federal Acquisition Regulation 35.017, and a national security laboratory, as defined by 50 U.S.C. 2471, whose multidisciplinary research capabilities, tools, and teams of experts focus on the nation's priorities in science, energy, and national security. The purpose of FFRDCs is to bring scientific and technical expertise to bear on pressing national challenges. SNL personnel participate in the formal annual weapons certification process of the nuclear weapons stockpile. Through routine surveillance of the systems and annual stockpile assessment, weapons issues that could lead to future performance degradation, such as aging effects, are discovered and addressed. SNL/NM personnel also focus on developing technologies to sustain, modernize, and protect the nuclear arsenal; prevent the spread of weapons of mass destruction; defend against terrorism; protect the national infrastructure; ensure stable energy and water supplies; and provide new capabilities to the Department of Defense.

SNL personnel also perform research and development in science, technology, and engineering programs. SNL/NM operations are primarily sponsored by NNSA, but SNL personnel also do work for other governmental agencies and partner with a wide variety of entities.

SNL/NM is located within KAFB to the southeast of Albuquerque, NM. KAFB spans approximately 50,000 acres located at the foothills of the Manzano Mountains. The SNL/NM campus covers approximately 16,000 acres on KAFB and contains approximately 900 buildings with approximately seven million square feet. The SNL/NM eastern boundary is U.S. Forest Service land, and the southern boundary is Pueblo of Isleta land. The new SNL/NM SWEIS will analyze SNL/NM operations within KAFB and the City of Albuquerque area where SNL/NM has leased facilities. SNL/NM contains five secure technical areas on DOE fee-owned land as well as buildings and structures on properties permitted from KAFB, including Coyote Test Field, National Solar Thermal Test Facility,

Robotic Vehicle Range, remote testing sites, and others.

SNL/NM currently operates under a SWEIS issued in 1999, *Final Site-Wide EIS for Sandia National Laboratories, New Mexico* (1999 SNL/NM SWEIS; DOE/EIS-0281), its four supplement analyses (SAs) (DOE/EIS-0281-SA-01, 2001; DOE/EIS-0281-SA-02, 2002; DOE/EIS-0281-SA-03, 2004; and DOE/EIS-0281-SA-04, 2006), and other project-specific NEPA documents.

The 1999 SNL/NM SWEIS examined existing and potential impacts to the environment from ongoing and anticipated future NNSA operations conducted over approximately a 10-year period for SNL/NM operations within and around KAFB. Since issuance of the 1999 SNL/NM SWEIS and its associated ROD (64 FR 69996; December 15, 1999), SNL/NM operations have evolved and additional information about the SNL/NM environmental setting has become available. Security requirements have also evolved in response to changes in recognized threats.

An SA is a document prepared pursuant to DOE NEPA regulations (10 CFR 1021.314(c)) to determine whether a supplemental or new EIS should be prepared, or whether no further NEPA documentation is required. Three of the four SNL/NM SAs based on the 1999 SNL/NM SWEIS dealt with implementing new or changed operations and replacing facilities; the fourth SA (DOE/EIS-0281-SA-04, August 2006), prepared pursuant to 10 CFR 1021.330(d), assessed whether potential environmental impacts from site operations remained within those projected in the 1999 SNL/NM SWEIS for the level of operations selected in the ROD. Based on each of these SAs, NNSA determined that a new SWEIS was not necessary.

Subsequently, given the length of time since the previous SWEIS was issued, new information, and the evolution of mission needs, NNSA determined that preparation of a new SWEIS was appropriate. On June 24, 2011, NNSA issued a notice of intent (NOI) to prepare a new SWEIS for SNL/NM (76 FR 37100). NNSA's completion of that SWEIS, however, was delayed by competing program and resource priorities. Since the NOI was issued in 2011, mission needs have continued to evolve and further information has become available. Consequently, NNSA has now determined that preparation of a new SWEIS with a fresh scoping process would best serve the purposes of NEPA by providing NNSA and the public with the most current environmental and programmatic information. Accordingly, NNSA has

administratively canceled the SWEIS originally announced in 2011 and will prepare a new SWEIS, DOE/EIS-0556.

Purpose and Need for Agency Action

The purpose and need for continued operation of SNL/NM has not changed from those identified in the 1999 SNL/NM SWEIS and continues to include supporting NNSA and other DOE missions as directed by Congress and the President. Currently, facilities and capabilities that support many NNSA and other DOE mission priorities are found only at SNL/NM. NNSA needs to continue SNL/NM operations to meet its core mission requirements. A further purpose of the continued operation of SNL/NM is to provide capabilities available at the site in support of strategic partnership projects, under which SNL/NM oversees national security-related research, development, and testing programs, and conducts work for other entities, including other federal and state government agencies, industry, and academic institutions.

SNL/NM operations support the following NNSA mission priorities: (1) to enhance U.S. national security through the military application of nuclear energy, (2) to maintain and enhance the safety, reliability, and performance of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test, in order to meet national security requirements, (3) to promote international nuclear safety and nonproliferation, (4) to reduce global danger from weapons of mass destruction; and (5) to support U.S. leadership in science and technology (50 U.S.C. 2401).

SNL/NM operations support NNSA national security objectives through the engineering of nuclear weapons components and other nuclear and non-nuclear activities. NNSA missions for SNL/NM have evolved over time in response to national needs, and NNSA expects that evolution will continue for the foreseeable future. NNSA, on behalf of the U.S. Government, requires SNL/NM management and operating contractor to continue providing support for NNSA mission lines, programs, and projects in national security, energy resources, environmental quality, and science and technology. SNL personnel maintain specific core competencies in activities associated with research, development, design, and surveillance of nuclear weapons; supports the assessment and certification of their safety, reliability, and performance; and produces components for the stockpile. The continued operation of SNL/NM is

critical to NNSA's ability to meet its missions.

SNL/NM operations also include non-weapons research and science services in multiple areas, including waste management, environmental restoration, hazardous and radioactive material transportation, energy efficiency and renewable energy, nuclear energy, fossil energy, magnetic fusion, basic energy sciences, supercomputing, and biological and environmental research. SNL/NM operations are needed to support other important DOE missions, including energy security and long-term energy needs, transportation research and development, homeland infrastructure security and resiliency, and advanced science and technology. Much of the same infrastructure used to support national security supports these other missions.

Preliminary Alternatives

The scoping process is an opportunity for the public to assist NNSA in determining the alternatives, issues, and analyses that should be included in the SNL/NM SWEIS. NNSA welcomes specific comments or suggestions on the content of these alternatives or on other alternatives that should be considered. NNSA has identified a preliminary set of alternatives and issues for evaluation in the SNL/NM SWEIS below; during the development of the SWEIS, NNSA could identify and include other reasonable alternatives.

No-Action Alternative

Under the No-Action Alternative, current operations throughout SNL/NM that support currently assigned missions would continue. NEPA regulations require analysis of the No-Action Alternative to provide a benchmark for comparison with the environmental effects of action alternatives. This alternative represents maintaining the status quo and would include the programs and activities for which NEPA reviews have been completed and decisions have been made.

Modernized Operations Alternative

Under the Modernized Operations Alternative, existing programs and activities would continue and be supported by modernizing facilities. This alternative includes the scope of the No-Action Alternative, as described above, plus additional modernization activities. This alternative includes (1) construction of replacement facilities, (2) upgrades to existing facilities and infrastructure, and (3) decontamination, decommissioning, and demolition (DD&D) projects. Under this alternative, NNSA would replace facilities that are

approaching their end-of-life, upgrade facilities to extend their lifetimes, and improve work environments to enable NNSA to meet operational requirements. The alternative would also include projects that would reduce the carbon footprint of operations and/or are net zero initiatives. The proposed DD&D of older facilities would eliminate excess facilities and reduce costs and risks. This alternative would not expand capabilities and operations at SNL/NM beyond those that currently exist. Examples of projects that will likely be proposed and analyzed in the SNL/NM SWEIS under this alternative include: (1) Neutron Generator Enterprise Consolidation, which would consolidate operations from existing facilities into a new facility that would have improved workflow; and (2) Weapons Component Engineering Capability, which would consolidate capabilities from existing facilities into a new facility.

Expanded Operations Alternative (NNSA's Preferred Alternative)

The Expanded Operations Alternative would include the modernization actions included in the Modernized Operations Alternative, as described above. This alternative would expand operations and missions to respond to future national security challenges and meet increasing requirements. This alternative includes (1) construction and operation of new facilities and (2) upgrades to existing facilities that result in changing the nature and capabilities of these facilities. This alternative would expand capabilities at SNL/NM beyond those that currently exist. Examples of projects that will likely be proposed and analyzed in the SNL/NM SWEIS under this alternative include: (1) Combined Radiation Environments for Survivability Testing (CREST) facility, which would replace the Annular Core Research Reactor (ACRR), which is reaching its end-of-life. Because the CREST facility would expand the capabilities and support additional missions compared to the existing ACRR, it would be proposed under the Expanded Operations Alternative; and (2) Next Generation Pulsed Power Facility, which would address important nuclear weapon primary and secondary physics questions and would produce large x-ray and neutron outputs that would help certify weapons survivability in hostile environments in larger test objects than possible today. Such a capability does not currently exist at SNL/NM.

In the Draft SNL/NM SWEIS, NNSA will identify and analyze other actions

and specific projects that could expand the capabilities at SNL/NM.

Other Alternatives

Although the 1999 SNL/NM SWEIS included a Reduced Operations Alternative, NNSA does not plan to analyze such an alternative in the new SNL/NM SWEIS. NNSA does not consider a reduction in operations to be a reasonable alternative under NEPA because it does not meet the purpose and need for agency action. That is, under a reduced operations alternative, NNSA would not be able to meet its essential mission needs for the foreseeable future. NNSA welcomes comments on this and any other alternative the public thinks are reasonable and should be analyzed in the SWEIS.

Preliminary Identification of Environmental Issues

The issues listed below have been identified for analysis in the SNL/NM SWEIS. The list is tentative and intended to facilitate public comment on the scope of the document. It is not intended to be all inclusive, nor does it imply any predetermination of potential impacts. NNSA invites suggestions for the addition or deletion of items on this list.

- Potential effects on the public and workers from exposures to radiological and hazardous materials during normal operations, construction, reasonably foreseeable accidents (including from natural phenomena hazards), and intentional destructive acts;
- Impacts on surface water, groundwater, floodplain and wetlands, and on water use and quality;
- Impacts on air quality from potential releases of radiological and non-radiological pollutants;
- Impacts associated with climate change, including greenhouse gas emissions and reductions, potential effects of climate change on analyzed alternatives, and potential mitigation measures;
- Impacts to plants and animals and their habitats, including species that are federally or state listed as threatened or endangered, or of special concern;
- Impacts on physiography, topography, geology, and soil characteristics;
- Impacts to cultural resources, such as those that are historic, prehistoric, archaeological, scientific, or paleontological;
- Socioeconomic impacts to affected communities;
- Environmental justice impacts, particularly whether or not activities at SNL/NM would have a

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disproportionately high and adverse effect on minority and/or low-income populations;

- Impacts on land use and applicable plans and policies;
- Impacts from traffic and transportation of radiological and hazardous materials/waste;
- Pollution prevention and materials and waste management practices and activities;
- Impacts of SNL/NM facilities on visual aesthetics of the surrounding communities and ambient environment;
- Impacts of noise and vibration on the surrounding communities and ambient environment;
- Impacts to community services, including fire protection, police protection, schools, and solid waste disposal to landfills;
- Impacts from the use of utilities, including water and electricity consumption, fuel use, sewer discharges, and resource conservation;
- Impacts from site contamination and remediation;
- Unavoidable adverse impacts;
- Environmental compliance and inadvertent releases;
- Energy conservation, renewable energy, and sustainability;
- Short-term uses and long-term productivity;
- Irreversible and irretrievable commitment of resources;
- Cumulative effects of past, present, and reasonably foreseeable future actions; and
- Mitigation commitments.

NEPA Requirements and the SWEIS Process

DOE NEPA implementing regulations at 10 CFR 1021.330(c), state: “[A]s a matter of policy when not otherwise required, DOE shall prepare site-wide EISs for certain large, multiple-facility DOE sites; DOE may prepare EISs or EAs for other sites to assess the impacts of all or selected functions at those sites.” NNSA has determined that preparation of a new SWEIS for SNL/NM is appropriate and is preparing the SNL/NM SWEIS in accordance with NEPA, and CEQ and DOE regulations implementing NEPA (40 CFR parts 1500–1508 and 10 CFR part 1021, respectively).

NNSA will solicit public input at two points in the SNL/NM SWEIS process: during the scoping process announced by this Notice, and after issuance of a draft SNL/NM SWEIS. The scoping process is intended to involve all interested parties, including agencies (federal, state, and local), public interest groups, tribes, local businesses, industry, organizations, and members of

the public. Interested parties are invited to participate in the SNL/NM SWEIS process to refine the preliminary alternatives and identify environmental issues for analysis. NNSA will consider all comments received during the Comment Period in defining the scope of the SNL/NM SWEIS. Comments on the proposed scope may be provided verbally at the two public scoping meetings described under the **DATES** section, or in writing by any of the means described under the **ADDRESSES** section. The scoping meetings will provide the public with an opportunity to present comments, ask questions, and discuss issues with NNSA officials regarding the SNL/NM SWEIS.

Following the scoping process announced in this Notice, and after consideration of comments received during scoping, NNSA will prepare a Draft SNL/NM SWEIS. NNSA anticipates issuing the Draft SNL/NM SWEIS to the public in 2024. NNSA will announce the availability of the Draft SNL/NM SWEIS in the **Federal Register** and local media outlets. NNSA will consider comments received on the Draft document and will address them in the Final SNL/NM SWEIS, which the NNSA anticipates issuing to the public in 2025. NNSA will then issue a ROD no sooner than 30 days after publication by the Environmental Protection Agency of a Notice of Availability of the Final SNL/NM SWEIS.

Preparation of the SNL/NM SWEIS will require participation of other federal agencies. Accordingly, NNSA invites agencies with jurisdiction by law or special expertise to participate in the SNL/NM SWEIS process. NNSA has invited the U.S. Air Force and U.S. Forest Service to participate as cooperating agencies in preparation of the document.

Signing Authority

This document of the Department of Energy was signed on April 17, 2023, by Jill Hruby, Under Secretary for Nuclear Security and Administrator, NNSA, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on April 18, 2023.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

[FR Doc. 2023-08459 Filed 4-20-23; 8:45 am]

BILLING CODE 6450-01-P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

Notice of Staff Attendance at North American Electric Reliability Corporation Standard Drafting Team Meetings

The Federal Energy Regulatory Commission hereby gives notice that members of the Commission and/or Commission staff may attend the following meetings:

North American Electric Reliability Corporation Project 2021-07 Extreme Cold Weather Grid Operations, Preparedness, and Coordination Standard Drafting Team Meetings on:

April 18, 2023 (1 p.m.–3 p.m. eastern time)

April 20, 2023 (1 p.m.–3 p.m. eastern time)

April 27, 2023 (1 p.m.–2:30 p.m. eastern time)

Further information regarding these meetings may be found at: <https://www.nerc.com/Pages/Calendar.aspx>.

The discussions at the meetings, which are open to the public, may address matters at issue in the following Commission proceeding:

Docket No. RD23-1-000 Extreme Cold Weather Reliability Standards EOP-011-3 and EOP-012-1

For further information, please contact Chanel Chasanov, 202-502-8569, or chanel.chasanov@ferc.gov.

Dated: April 17, 2023.

Debbie-Anne A. Reese,

Deputy Secretary.

[FR Doc. 2023-08467 Filed 4-20-23; 8:45 am]

BILLING CODE 6717-01-P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

Combined Notice of Filings #1

Take notice that the Commission received the following electric corporate filings:

Docket Numbers: EC23-72-000.
Applicants: Chevelon Butte RE LLC, Arizona Public Service Company.



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DOE Evaluation

DOE will review the Notice and Supplement in accordance with its CIC Procedures.² Consistent with the CIC Procedures, this notice addresses Commonwealth's existing authorization to export LNG to countries with which the United States has not entered into a free trade agreement (FTA) requiring national treatment for trade in natural gas and with which trade is not prohibited by United States law or policy (non-FTA countries), granted in DOE/FECM Order no. 5238-A.³ If no interested person protests the change in control and DOE takes no action on its own motion, the proposed change in control will be deemed granted 30 days after publication in the **Federal Register**. If one or more protests are submitted, DOE will review any motions to intervene, protests, and answers, and will issue a determination as to whether the proposed change in control has been demonstrated to render the underlying authorizations inconsistent with the public interest.

Public Comment Procedures

Interested persons will be provided 15 days from the date of publication of this notice in the **Federal Register** to move to intervene, protest, and answer Commonwealth's Notice and Supplement.⁴ Protests, motions to intervene, notices of intervention, and written comments are invited in response to this notice only as to the change in control described in the Notice and Supplement. All protests, comments, motions to intervene, or notices of intervention must meet the requirements specified by DOE's regulations in 10 CFR part 590, including the service requirements.

Filings may be submitted using one of the following methods:

(1) Submitting the filing electronically at fergas@hq.doe.gov;

(2) Mailing the filing to the Office of Regulation, Analysis, and Engagement at the address listed in the **ADDRESSES** section; or

(3) Hand delivering the filing to the Office of Regulation, Analysis, and Engagement at the address listed in the **ADDRESSES** section.

For administrative efficiency, DOE prefers filings to be filed electronically.

² 79 FR 65541 (Nov. 5, 2014).

³ Commonwealth's Notice and Supplement also applies to the company's existing authorization to export LNG to FTA countries in the same docket. DOE will respond to that portion of the filing separately pursuant to the CIC Procedures, 79 FR 65542.

⁴ Intervention, if granted, would constitute intervention only in the change in control portion of these proceedings, as described herein.

All filings must include a reference to "Docket No. 19-134-LNG" in the title line, or "Commonwealth LNG Change in Control" in the title line. Filings must be submitted in English to be considered.⁵

For electronic submissions: Please include all related documents and attachments (e.g., exhibits) in the original email correspondence. Please do not include any active hyperlinks or password protection in any of the documents or attachments related to the filing. All electronic filings submitted to DOE must follow these guidelines to ensure that all documents are filed in a timely manner.

The Notice, Supplement, and any filed protests, motions to intervene, notices of intervention, and comments will be available electronically on the DOE website at www.energy.gov/fecm/regulation.

Signed in Washington, DC, on November 13, 2025.

Amy R. Sweeney,
Director, Office of Regulation, Analysis, and Engagement, Office of Resource Sustainability.

[FR Doc. 2025-20043 Filed 11-17-25; 8:45 am]

BILLING CODE 6450-01-P

DEPARTMENT OF ENERGY**National Nuclear Security Administration**

Notice of Change in the Process for the Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico and for the Supplemental Environmental Impact Statement for Enhanced Plutonium Facility Utilization at Lawrence Livermore National Laboratory

AGENCY: National Nuclear Security Administration, Department of Energy.

ACTION: Notice.

SUMMARY: The National Nuclear Security Administration (NNSA), a semi-autonomous agency within the United States (U.S.) Department of Energy (DOE), announces it will not perform certain National Environmental Policy Act (NEPA) activities previously indicated in the *Notice of Intent To Prepare a Site-Wide Environmental Impact Statement (SWEIS) for Continued Operation of Sandia National Laboratories, New Mexico (SNL/NM) in Albuquerque, New Mexico (SNL/NM NOI) and the Notice of Intent*

To Prepare a Supplemental Environmental Impact Statement (SEIS) for Enhanced Plutonium Facility Utilization at Lawrence Livermore National Laboratory (LLNL) in Livermore, California (LLNL NOI). Due to intervening regulatory changes, NNSA will not publish a draft SNL/NM SWEIS or a draft LLNL SEIS or hold additional public hearings for the LLNL SEIS. When NNSA publishes the final SNL/NM SWEIS and the final LLNL SEIS, NNSA will publish its Records of Decision (RODs) for both at the same time as the final documents.

FOR FURTHER INFORMATION CONTACT: For additional information about this Notice, please contact Lynn Alexander, NEPA Compliance Officer, National Nuclear Security Administration; telephone: 202-302-0141; or email at: NEPA@nnsa.doe.gov.

SUPPLEMENTARY INFORMATION: Consistent with Executive Order (E.O.) 14154, *Unleashing American Energy*, and with the *National Environmental Policy Act of 1969*, as amended (42 U.S.C. 4321 et seq.), the Council on Environmental Quality (CEQ) repealed its NEPA regulations and required agencies to revise their NEPA implementing procedures (90 FR 10610, February 25, 2025, *Removal of National Environmental Policy Act Implementing Regulations*; effective April 22, 2025). Accordingly, DOE issued new DOE NEPA Implementing Procedures on June 30, 2025, and removed most of the previous DOE NEPA implementing procedures from 10 CFR part 1021, *National Environmental Policy Act Implementing Procedures*, in an Interim Final Rule on July 3, 2025 (90 FR 29676, *Revision of National Environmental Policy Act Implementing Procedures*). DOE's amended NEPA regulations rescind process-oriented requirements (which are now outlined in the DOE NEPA Implementing Procedures document issued June 30, 2025) and retain DOE's Categorical Exclusions and emergency procedures. The regulatory update and new DOE NEPA Implementing Procedures align with E.O. 14154 and significantly streamline NEPA processes by focusing on statutory requirements while retaining meaningful review of potential environmental impacts. Neither NEPA nor the new DOE NEPA Implementing Procedures require NNSA to publish draft environmental documents for public comment, hold public hearings on a draft environmental document, or wait for 30 days after issuance of a final environmental impact statement to publish a ROD. While NNSA indicated in the SNL/NM NOI that it would

⁵ Executive Order 14224 of March 1, 2025, *Designating English as the Official Language of the United States*, 90 FR 11363 (Mar. 6, 2025).

publish a draft of the SWEIS for Continued Operation of SNL/NM (DOE/EIS-0556) for public comment, consistent with NEPA and with DOE's new DOE NEPA Implementing Procedures, with respect to SNL/NM, NNSA will not issue a draft SNL/NM SWEIS for public comment or wait 30 days between the final SWEIS and issuance of the ROD. While NNSA indicated in the LLNL NOI that it would publish a draft of the LLNL SEIS for Enhanced Plutonium Facility Utilization at LLNL in Livermore, California (DOE/EIS-0547-S1) for public comment, consistent with NEPA and DOE's new DOE NEPA Implementing Procedures, NNSA will not issue a draft LLNL SEIS for public comment, hold a public hearing on a draft, or wait 30 days between the final LLNL SEIS and issuance of the ROD.

NEPA Activity Already Conducted on the SWEIS for Continued Operation of SNL/NM

NNSA is preparing the SNL/NM SWEIS pursuant to the requirements of NEPA. In the SNL/NM NOI (April 21, 2023; 77 FR 24607) NNSA invited all interested agencies (Federal, state, and local), Native American Tribes, public interest groups, local businesses, and members of the general public to provide comments on the scope of the environmental impact statement, environmental issues, and other potential alternatives that NNSA should consider in the SNL/NM SWEIS. NNSA held two public scoping meetings regarding the SNL/NM SWEIS in May 2023 and collected comments from the interested parties for 45 days. NNSA has considered and incorporated comments received during the public scoping period and expects to publish the final

SNL/NM SWEIS and simultaneous publication of its ROD in late 2025.

NEPA Activity Already Conducted on the SEIS for Enhanced Plutonium Facility Utilization at LLNL

In the LLNL NOI (January 13, 2025; 90 FR 2678), NNSA announced its intent to prepare the LLNL SEIS and invited all interested agencies (Federal, state, and local), Native American Tribes, public interest groups, local businesses, and members of the general public to provide comments on the scope of the environmental impact statement, environmental issues, and other potential alternatives that NNSA should consider in the LLNL SEIS. NNSA held a public scoping meeting regarding the LLNL SEIS in January 2025 and collected comments from the interested parties for 45 days. NNSA has considered and incorporated comments received during the public scoping period and expects to publish the final LLNL SEIS and simultaneous publication of its ROD in early 2026.

Signing Authority

This document of the Department of Energy was signed on October 2, 2025, by Brandon M. Williams, Under Secretary for Nuclear Security and NNSA Administrator, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters

the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on November 14, 2025.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

[FR Doc. 2025-20208 Filed 11-17-25; 8:45 am]

BILLING CODE 6450-01-P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

Sunshine Act Meetings

The following notice of meeting is published pursuant to section 3(a) of the government in the Sunshine Act (Pub. L. 94-409), 5 U.S.C. 552b:

AGENCY HOLDING MEETING: Federal Energy Regulatory Commission.

TIME AND DATE: November 20, 2025, 10:00 a.m.

PLACE: Room 2C. 888 First Street NE, Washington, DC 20426.

STATUS: Open to the public.

MATTERS TO BE CONSIDERED: Agenda

* Note—Items listed on the agenda may be deleted without further notice.

CONTACT PERSON FOR MORE INFORMATION: Debbie-Anne A. Reese, Secretary. Telephone (202) 502-8400.

For a recorded message listing items Stricken from or added to the meeting, call (202) 502-8627.

This is a list of matters to be considered by the Commission. It does not include a listing of all documents relevant to the items on the agenda. All public documents, however, may be viewed online at the Commission's website at <https://elibrary.ferc.gov/eLibrary/search> using the eLibrary link.

1130TH—MEETING

[Open; November 20, 2025, 10:00 a.m.]

Item No.	Docket No.	Company
Administrative		
A-1	AD26-1-000	Agency Administrative Matters
A-2	AD26-2-000	Customer Matters, Reliability, Security and Market Operations
A-3	AD06-3-000	Market Update
A-4	AD07-13-019	FY2025 Report on Enforcement
Electric		
E-1	ER25-2258-001	System Energy Resources, Inc.
E-2	ER22-24-002	System Energy Resources, Inc.
E-3	ER24-3032-000	Pacific Gas and Electric Company
E-4	ER10-1391-003	San Diego Gas & Electric Company
E-5	ER24-2776-000 ER24-2776-001	Southern California Edison Company
E-6	EL25-111-000	EDF power solutions Development, Inc.

References

88 FR 24607. “Notice of Intent To Prepare a Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico,” *Federal Register*, National Nuclear Security Administration, U.S. Department of Energy, April 21, 2023. Available online:

<https://www.energy.gov/sites/default/files/2023-04/noi-eis-0556-snl-site-wide-2023-04.pdf>.

90 FR 51732. “Notice of Change in the Process for the Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico and for the Supplemental Environmental Impact Statement for Enhanced Plutonium Facility Utilization at Lawrence Livermore National Laboratory,” *Federal Register*, National Nuclear Security Administration, U.S. Department of Energy, November 18, 2025. Available online:

<https://www.govinfo.gov/content/pkg/FR-2025-11-18/pdf/2025-20208.pdf>.

APPENDIX H
COMMON OPERATIONS TO ALL ALTERNATIVES
AND CATEGORICAL EXCLUSIONS SUMMARY

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Appendix H

Common Operations to All Alternatives, and Categorical Exclusions Summary

H.1 INTRODUCTION

H.1.1 Balance of Operations and Common Operations to All Alternatives

Under the No-Action Alternative and other evaluated alternatives, common activities and general operations are carried out at SNL/NM in support of national security priorities. The purpose of this appendix is to give additional insight into work activities that are commonly done on a day-to-day basis as part of the normal operation of SNL/NM, also known as “balance of operations,” as well as general activities associated with SNL/NM missions, portfolios, programs, and capabilities that are part of all alternatives. The environmental impact of balance of operations and common operations are accounted for in the evaluation of resource use and maintaining infrastructure necessary to operate SNL/NM.

This appendix broadly describes balance of operations and common operations in Section H.2. Balance of operations include business and administrative operations, routine activities such as maintenance, inspections, and support services. Mission enabling efforts commonly done that support regulatory compliance, facility and infrastructure maintenance, and environmental stewardship are presented in Section H.3.

All work at SNL/NM is reviewed and considered under applicable environmental and safety requirements. When SNL/NM personnel engage in activities on Kirtland Air Force Base (KAFB) property, additional environmental evaluation and deconfliction with KAFB is conducted.

H.1.2 Use of Categorical Exclusions as Appropriate

Groups of actions or activities that support missions, portfolios, programs, and capabilities and balance of operations activities may also meet the required standards for being excluded from additional environmental review (i.e., eligible for a categorical exclusion – meaning that those activities have been previously assessed and determined not to have significant impact on the environment). Categorical exclusions are not exemptions or waivers of review under National Environmental Policy Act of 1969 (NEPA); they are a type of NEPA review that includes assessment of actions, publication of the exclusion for public consideration, and subsequent adoption by the U.S. Department of Energy (DOE) (Title 10 *Code of Federal Regulations* [CFR] 1021).

To establish a categorical exclusion, federal agencies determine whether a proposed activity is one that, based on assessment and experience, normally does not require further environmental review. Once established, categorical exclusions provide an efficient tool to complete the NEPA environmental review process for proposals fitting within the confines of the categorical exclusion. The application of a categorical exclusion is limited by “extraordinary circumstances” and requires consideration of reasonably foreseeable effects. “Extraordinary circumstances” are factors or circumstances in which a normally excluded action may nevertheless have a significant environmental effect that requires further analysis via an environmental assessment or

environmental impact statement. Reasonably foreseeable effects reflect a holistic analysis of multiple concurrent activities, where the outcome of those many activities may sometimes result in a significant environmental effect even though the smaller, individual activities do not.

DOE NEPA 10 CFR Part 1021 identify classes of actions that DOE has determined do not have a significant effect on the human environment. Appendix A are considered administrative and routine actions not subject to NEPA review. Appendix B identifies conditions that are integral elements of the classes of actions that are categorically excluded. These conditions require that a proposed activity would not threaten to violate applicable statutory, regulatory, or permit requirements for environment, safety, or health; siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; disturb hazardous substances, pollutants, or contaminants that preexist in the environment; cause significant impacts on environmentally sensitive resources; and involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species.

H.2 BALANCE OF OPERATIONS

H.2.1 General SNL/NM Administrative Operations

This section reflects the general and common operations performed by SNL/NM on a day-to-day basis to support missions, portfolios, programs, and capabilities. Routine business, contracting, personnel management, inventory, and long-term planning are performed to support the operation and management of SNL/NM. Within this category, a variety of information-gathering functions are also performed, such as literature surveys, inventories searches, site visits, audits, data processing, and analysis. General administrative operations may include document preparation, information dissemination by electronic and hard copy publication and distribution, oral presentation, and electronic communication. Administrative operations necessary to support the normal conduct of SNL/NM business fall within administrative, financial, and personnel activities, including but not limited to:

- financial management and planning;
- program and project planning;
- auditing and assessment;
- administrative oversight;
- document destruction;
- purchase and delivery of supplies;
- classroom-style training;
- awards of contracts and agreements;
- execution of leases, licenses, rights-of-way, and easements along with supporting permitting activities;
- property transfers (e.g., equipment, materials, real property, samples, data); and
- scheduling and performing travel related tasks.

In the course of daily work, SNL/NM personnel will travel; consult; attend conferences; and provide educational activities and training to local, state, tribal, federal agencies, and private entities. SNL/NM personnel may provide technical advice and planning assistance, conduct site visits and audits, offer technology or science demonstrations, recruit, and engage in other similar activities.

H.2.1.1 Emergency Preparedness Planning, Long-Term Planning, and Process Document Development.

SNL/NM conducts emergency preparedness planning and creates long-term planning documents along with creating, implementing, and updating organization and procedures. Examples of emergency preparedness planning include supporting emergency preparedness, response activities and offsite recovery associated with security events, creating and maintaining emergency preparedness plans for onsite and offsite operations, and training and operations support to be protective of health and safety.

Long-term management planning includes site facility plans, facility assessments, and facility improvement/replacement lists. Document development includes creation, revision, and management of organizational or procedural documents. Examples of procedural documents include:

- plans or internal SNL/NM documents that assist in the planning or organization of SNL/NM operations; and
- documents that create, support, or modify formal policies, orders, notices, manuals, and guides.

H.2.1.2 Information Gathering, Analysis, and Dissemination

SNL/NM performs information gathering at SNL/NM, within the United States, and around the world.

Examples of information gathering, analyses, and dissemination include:

- accessing published data and literature through online databases and clearinghouses;
- exchanging information and data at professional conferences;
- soliciting data and published information and providing expertise from trained professionals and recognized experts;
- auditing internal and external scientific projects and/or programs;
- extracting, classifying, inspecting, cleaning, transforming, or modeling data;
- applying statistical, structural, exploratory, and confirmatory models;
- computer simulation and visualization data mining;
- publishing data, information, and research results; and

- sharing data, information, and research results among colleagues, universities, government agencies, other institutions, and the public via print, electronic, or other media.

H.2.1.3 Technical Advice and Assistance to Organizations

SNL/NM experts provide technical advice and planning assistance to private, local, state, tribal, and federal entities within the United States and around the world.

Examples of technical assistance and exchange include:

- providing technical assistance to a university student or researcher;
- advising public, private, and tribal entities based on the findings of scientific research;
- providing technical assistance on the operation of a scientific instrument to foreign or domestic visitors provided that export control requirements are met;
- serving on multidisciplinary teams supporting other government agencies;
- identifying and analyzing another country's energy, security, and environmental resources, needs, and options; and
- accepting appointments to advisory groups or participating in workshops.

H.2.2 Routine Maintenance Activities

Day-to-day maintenance for operational support of SNL/NM facilities including infrastructure fall within the routine maintenance activities. Routine maintenance ranges from ongoing custodial services to corrective and preventive activities required for facility ingress and egress, and activities to maintain and preserve facilities, structures, roads, infrastructure, and equipment in a condition suitable for fulfilling their designated purpose. These activities are performed to maintain current operations through repairs and replacements but not to substantially extend the useful life of a facility. The activities do not allow for substantial upgrades or improvements. Maintenance occurs at all SNL/NM-managed lands and occasionally at offsite leased facilities. All routine maintenance activities are performed consistent with applicable law, rules, regulations, and policies, inclusive of cultural resource and environmental clearances as appropriate.

Examples of routine maintenance activities include, but are not limited to:

- maintenance and repair to interior and exterior of existing facilities to include doors (including rollups), windows, support structures, walls, ceilings, roof (including downspouts, gutters), floors, reroofing, custodial services (including changing air filters, managing janitorial staff, ensuring supplies are stocked), janitorial services (including mopping, sanitizing bathrooms, dusting, taking out trash and recycling), utilities (including electrical, water including plumbing, gas, sewer, communications including fiber optics, storm), and fixtures (such as ductwork, pipes, conduit, lighting, wiring, outlets, covers, duct banks, and junction boxes);

- maintenance, repair, and/or control of erosion, soil, and/or drainage problems around facilities, including detention and retention ponds (including bio, gravels, and containment), stabilization measures (such as reseeding or revegetation), channels, drains, berms, and bioswales;
- maintenance, repair, installation, removal, disposal, and operation of landscaping and lawn care including application of herbicides and pesticides in accordance with use instructions and applicable regulations (including use limitations for endangered species protections), mowing, trimming, revegetation, and irrigation systems;
- maintenance, repair, installation, removal, disposal, and operation of construction equipment (heavy machinery, trucks, and cranes), laboratory equipment (compressed air systems, gas systems, instruments, cranes), fire equipment (detectors, fire extinguishers, fire hydrants, sprinkler systems, suppression systems), electrical equipment (lighting, machines, compressors, generators, transformers, pumps, hydraulic motors, remote control panels), elevators, hand rails, ladders, stairs, ramps, temporary and permanent fencing, gates (pedestrian and vehicle), pressure vessels, structures, safety and health equipment (such as eyewash stations, safety showers, radiation monitoring devices, fume hoods and associated collection and exhaust systems, automated external defibrillator devices, portable restrooms, lactation pods), alarms/safeguards/security equipment-security systems (alarms, access systems, control/surveillance systems), safety systems (shutdown systems, announcement and emergency warning systems, cooling systems, remote monitoring, controllers, protection systems, spill containment systems, criticality and radiation monitors), environmental controls (temperature, humidity, airflow, air and water quality, noise, and vibration, water consumption monitors and flow control systems), structural platforms (catwalks, walkways, and concrete pads), steam plants, cooling water systems (such as cooling towers, ponds, and pipes);
- modifications within or contiguous to an existing structure, in a previously disturbed or developed area, to enhance workplace habitability including, but not limited to maintenance, repair, installation, removal, disposal, and operation of mechanical equipment (e.g., heating, ventilation, and air conditioning [HVAC] systems - heating [boilers, hot water heaters, space heaters, gas or electrical heating furnaces, thermostats, and ducts], ventilation [window screens, exhaust fans, ducts, ceiling fans, and forced air flow], and air conditioning [central air, ducts, window units, evaporative coolers, covers for roof-mounted/window-mounted coolers, mini-splits, and refrigeration units] and/or its instrumentation), radiation shielding, and noise control/reduction;
- installation of or improvements to, and/or operation of facilities lighting, above and below ground utilities (electrical, water, storm, gas, sewer, communication) including potholing, temporary and permanent disconnection of utilities and their disposal; ingress/egress systems, environmental controls, fire alarm and control systems (fire suppression equipment, sprinklers, standpipes), backflow preventors, steam, condensate, chill water, chlorination, and reverse osmosis/deionization/treatment systems;
- maintenance, repair, inspection, service, removal, and disposal of vehicles and equipment including cranes, hoists, fleet vehicles, portable and backup generators (gas, diesel, solar), and other vehicles/equipment used for maintenance activities (mowers, trimmers, blowers, utility golf carts, etc.);

- maintenance and repair of existing roads and parking areas/lots including repaving, resurfacing such as grading/blading dirt roads/areas that previously were graded; snow removal, fixing potholes, painting markers, bollards, shoulders, bar ditches, bridges, culverts, sidewalks, pedestrian walkways and trails, bicycle paths, small outdoor fitness areas, parking signs, safety signs, direction markers, traffic signs, guard rails, and streetlights;
- delivery and rearrangements of equipment and furniture in and around facilities; and
- routine decontamination of surfaces of equipment, rooms, hot cells, or other interiors of buildings including wiping, strippable latex, and minor vacuuming, not including spent nuclear fuel or special nuclear material in nuclear reactors.

H.2.3 Routine Inspections and Support Services

SNL/NM performs routine facility support and inspection. Examples of routine inspections and analysis operations include, but are not limited to:

- asbestos and lead-based paint surveys;
- environmental monitoring, sampling, and analysis (onsite, local, and regional agricultural products, plants, animals, water, soil, and sediments);
- equipment inspections;
- identification of polychlorinated biphenyls (PCB)-containing equipment;
- routine sampling for chemical and radiation hazards;
- safety inspections;
- tests and inspections of fire protection systems; and
- water supply sampling and analysis.

Examples of support services for facility operation include, but are not limited to:

- delivery of supplies and equipment;
- equipment calibration and installation;
- material shipping in accordance with U.S. Department of Transportation regulations;
- mobile equipment gas/fuel service;
- pickup and recycling of paper, scrap metal, and surplus equipment;
- computing and printing/photographic services;
- disposition of contaminated expendable supplies (labware, gloves, clothing) and treatment/disposal in permitted facilities;
- relocation and transportation of chemicals, explosives, and equipment onsite per appropriate regulations; and

- waste transportation and permitted treatment/disposal for existing waste streams specific to routine maintenance and custodial activities.

H.3 SNL/NM GENERAL MISSION ENABLING OPERATIONS INCLUDED IN ALL ALTERNATIVES

H.3.1 Air, Terrestrial, and Water Monitoring

Air, soil, and sediment sampling and shipping occurs regularly from a variety of locations on SNL/NM-managed lands and KAFB property. Surface water monitoring stations are installed, maintained, and operated to measure flows, evaluate water quality, and test for contamination. Groundwater monitoring wells are installed, maintained, and sampled to measure water elevation and to measure and evaluate contamination. Locations for monitoring stations and wells are based on the site characteristics and presence of known or potential contamination. The locations are reviewed by cultural and ecological resource specialists to ensure protection of sensitive resources.

SNL/NM personnel support KAFB with wetland delineation fieldwork to determine the boundary between uplands and wetlands on KAFB property. Hydrology, hydric soils, and hydrophytic vegetation characteristics indicate the presence of wetlands.

H.3.2 Archaeological Surveying and Monitoring

SNL/NM surveys archaeological sites to evaluate site integrity and determine eligibility for the National Register of Historic Places. SNL/NM personnel also monitor construction sites if there is concern or need to protect archaeological sites. Sites are located on SNL/NM-managed lands and within the KAFB boundary. During a survey or monitoring, flagging, barriers, and/or fencing may be used to prevent archaeological disturbance or damage.

H.3.3 Biological Surveying and Monitoring

SNL/NM biologists conduct field studies to inventory, monitor, and assess vegetation and wildlife populations. Small-scale vegetation sampling and netting or live trapping is conducted to collect specimens for examination. Data collection can use wildlife cameras and trackers, and includes recording reproductive patterns, species distribution and densities, and habitat use. Specimens may be marked before release for later identification. Some trapping methods result in negligible mortality rates for small mammals, reptiles, and insects. Some samples may be collected from road-kills to evaluate diet or contamination. SNL/NM personnel also perform biological surveys near or at construction sites to protect nesting birds and wildlife. Surveying and monitoring sites are located on SNL/NM-managed lands and within the KAFB boundary. During a survey or monitoring, temporary flagging, barriers, and/or fencing may be used to prevent disturbance of the area. Material or samples may be shipped as needed.

H.3.4 Decontamination and Decommissioning of Vacated Facilities

SNL/NM decontaminates and decommissions vacant facilities (including buildings, structures, and utilities, such as septic tanks and manholes) determined to be excess to current and foreseeable needs. Decontamination may be a part of demolition activities. For each facility

proposed for demolition, expected waste hazards and volumes, environmental impact, and National Register of Historic Places status are identified prior to demolition.

H.3.5 Environmental Restoration and Compliance Activities

SNL/NM conducts a variety of environmental restoration and compliance activities in accordance with environmental regulations. SNL/NM conducts site characterization activities to identify potential release sites: landfills, pits, material disposal areas, solid waste management units, and areas of concern; septic and disposal tanks; waste and drain lines, leach fields, and outfalls; storage drums, tanks, and facilities; firing ranges and impact areas; existing or former buildings and bunkers; and subsurface contamination areas. SNL/NM also conducts final disposition of those areas proposed for no further investigation.

Environmental restoration and compliance field investigations are designed to determine the type and location of contaminants. Restoration and compliance field sampling activities may include monitoring air emissions, radiological screening, and contaminant screening for volatile organic vapors, inorganics, correctives, acids, and organics and focus on PCB transformers, operational releases, spills, contamination under existing and former buildings, and other miscellaneous solid waste management units or areas of concern. Some limited, small-scale studies or monitoring activities for restoration and compliance are performed such as air, groundwater, surface water, and stormwater monitoring, and soils and sediment sampling and characterization, and may be shipped to laboratories for processing as needed.

H.3.6 Geotechnical Investigations for Construction

During the planning and/or preconstruction phases for construction projects, geotechnical investigations (i.e., potholing) are performed prior to construction to validate the civil design and prevent damaging existing utilities and subsurface infrastructure.

H.3.7 Other Ongoing Maintenance and Operational Support

Some operational support activities extend beyond routine maintenance identified in Section H.2 and are completed to keep facilities and infrastructure in the best working order possible, to protect investments, and to extend the life of buildings and equipment. These activities take place at SNL/NM-managed lands, with appropriate KAFB permission on KAFB-permitted and -owned lands, and occasionally at offsite leased facilities. Examples of these activities include, but are not limited to:

- acquisition, installation, operation, modification, and removal of electricity transmission control and monitoring devices for grid demand and response, communication systems, and similar electronic equipment;
- construction, acquisition, and relocation of pathways and short access roads, consistent with applicable right-of-way conditions and approved land use or transportation improvement plans (including pedestrian walkways and trails, bicycle paths, small outdoor fitness areas, and short access roads);

- replacement or modification of air conditioning systems required for temperature control for operation of existing equipment;
- replacement and installation of fencing (including, but not limited to, temporary fencing during construction activities and border marking) that would not have the potential to significantly impede wildlife population movement or surface water flow;
- installation, replacement, or improvements to building equipment instrumentation (including, but not limited to, remote control panels, remote monitoring capability, alarm and surveillance systems, control systems to provide automatic shutdown, fire detection and protection systems, water consumption monitors and flow control systems,
- announcement and emergency warning systems, criticality and radiation monitors and alarms, and safeguards and security equipment);
- lead-based paint containment, removal, and disposal in accordance with applicable requirements;
- modifications within or contiguous to an existing structure, in a previously disturbed or developed area, or to enhance workplace habitability (including, but not limited to, installation or improvements to lighting, radiation shielding, HVAC and its instrumentation, and noise reduction);
- removal of asbestos-containing materials from buildings in accordance with applicable requirements;
- removal of PCB-containing items (such as transformers and capacitors), PCB-containing oils flushed from transformers, PCB-flushing solutions, and PCB-containing spill materials from buildings or other above-ground locations in accordance with applicable requirements;
- stormwater runoff control such as design, construction, and operation of control practices to reduce stormwater runoff and maintain natural hydrology (including vegetative practices, porous pavements, silt fences, straw wattles, fiber rolls, and green infrastructure) not associated with new construction; and
- traffic flow adjustments to existing roads, including stop sign or traffic light installation, adjusting direction of traffic flow and adding turning lanes, and widening and realigning roads that are within an existing right-of-way and consistent with approved land use or transportation improvement plans.

H.3.8 Outdoor Activities within KAFB Boundary

SNL/NM researchers conduct outdoor field experiments at study plots located on SNL/NM-managed lands and within the KAFB boundary. No work is allowed on KAFB property, including KAFB-permitted lands, without first complying with the Department of the Air Force's NEPA and other applicable requirements (such as acquiring siting, work request, or dig permits if necessary). Outdoor work may include, but is not limited to, data acquisition through sensor placement, environmental data collection operations (collecting data regarding weather, wind, temperature, vibration, seismicity, groundwater, soil vapor, sediment, water, air emissions, etc.), passive signal detection, low-powered emittance signaling for testing equipment (with

background levels), cultural and natural surveying and sampling, limited sample collection (e.g., limited grab samples; collection of soil, sediment, water), and digging. Dig permits are required for more than 12 inches (30.5 centimeters [cm]) on SNL/NM-owned lands and more than 4 inches (10.16 cm) on KAFB-permitted and -owned lands. Common equipment would include, but is not limited to, small hand tools, coring equipment, antennas, temporary canopies, chairs, shade structures, and tables.

Hydrological studies (e.g., erosion, water balance), carbon sequestration and carbon inventory studies, and other geochemistry and geology research are conducted. Laser-induced breakdown spectroscopy, light detection and ranging, and other high-energy sources are used, as well as soil, sediment, and groundwater sampling equipment, and runoff collection systems.

H.3.9 Relocation of Materials, Buildings, and Structures

SNL/NM relocates materials (e.g., clean fill, equipment, construction materials) and small buildings and structures (e.g., transportainers [shipping containers], trailers, tension domes, temporary structures for field work) from one site to another within SNL/NM-managed lands and the KAFB boundary. The materials, buildings, and structures are moved to existing developed and disturbed areas where major utilities and roads are available. Only relocations for which there are no changes in overall operations or increases in emissions or waste streams are included.

Relocations normally include the removal of construction debris and waste material, and capping, leaving in place, and/or removing unused utilities at the areas from which small buildings and structures are removed. Restoration activities at the affected sites may include revegetation, reseeding, erosion control, or recontouring.

H.3.10 Safety, Security, and Environmental Improvements to Facilities

SNL/NM routinely makes safety, security, and environmental improvements to facilities, including installation of and improvements to equipment for personnel safety and health. Other environmental improvements include minor operational changes and equipment additions or modifications that reduce the volume of waste produced and facilitate reuse and recycling of materials. These activities are conducted at all SNL/NM-managed lands, including leased spaces outside SNL/NM.

H.3.11 Site Characterization and Cleanup Activities

SNL/NM may engage in expedited cleanups, such as site characterization, removals, decontamination, interim measures (as defined in the Resource Conservation and Recovery Act), full-scale cleanup activities, and/or site closure.

H.4 ACTIVITIES THAT MAY BE EVALUATED FOR CATEGORICAL EXCLUSION

As a R&D laboratory, implementing new technologies and research initiatives is part of SNL/NM's mission. When new activities are proposed that have not been evaluated within this SWEIS or other NEPA review, they are considered in their entirety for a categorical exclusion or whether other NEPA analysis is required. When evaluating whether to apply a categorical

exclusion to a proposed activity, an agency must carefully consider the project description and specific circumstances associated with the activity and may not end its review based solely on the determination that the activity fits within the general description of the categorical exclusion. The agency must also consider the reasonably foreseeable effects of using multiple categorical exclusions and whether there are extraordinary circumstances that would warrant further NEPA review.

The regulations in 10 CFR 1021 Appendix B identifies categorical exclusions applicable to specific agency actions and Appendix C identifies adopted categorical exclusions per NEPA Section 109 that may be applicable to SNL/NM activities.

APPENDIX I
APPLICABLE LAWS, REGULATIONS AND
OTHER REQUIREMENTS

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Appendix I – Applicable Laws, Regulations and Other Requirements

I.1 INTRODUCTION

As part of the National Environmental Policy Act of 1969 (NEPA) process, an agency must consider whether a proposed action would violate applicable federal, state, or local law or requirement. This chapter identifies and summarizes applicable laws, regulations, and policies that may apply to the implementation of an alternative under this *Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico* (DOE/EIS-0556) (SNL/NM SWEIS).

It is U.S. Department of Energy (DOE) policy to conduct its operations in a manner that provides for the protection of public health, safety, and the environment, and in compliance with federal laws, regulations, and policies, including DOE directives. In general, federal statutes establish national policies by creating broad legal requirements that are implemented by regulations and policies. Identifying statutes, regulations, and orders relevant to the proposed federal action provides a legal framework for examining the proposed action and the alternatives and may serve as a basis for comparing impacts among the alternatives.

Implementation of certain federal laws may be consigned to a particular federal agency. For some environmental laws, such as the Clean Air Act of 1970, as amended (CAA) (Title 42 of the *United States Code* [42 U.S.C.] § 7401 et seq.), state agencies may be delegated responsibility for program implementation such as permitting and enforcement, with the U.S. Environmental Protection Agency (EPA) retaining program oversight. Other laws, such as NEPA (42 U.S.C. § 4321 et seq.), the Endangered Species Act (ESA) (16 U.S.C. §§ 1531–1544), and the Emergency Planning and Community Right-to-Know Act (EPCRA) (42 U.S.C. §§ 11001–11050) remain at the federal level for implementation or oversight.

Federal laws may also establish general compliance requirements that must be satisfied, but do not include permit and licensure processes. The Toxic Substances Control Act (TSCA) (15 U.S.C. § 2601 et seq.) (affecting polychlorinated biphenyls [PCBs] and other designated substances); the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. §§ 136–136y) (affecting pesticide and herbicide applications); the Hazardous Materials Act (HMTA) (49 U.S.C. §§ 5101–5128); and (in the event of a release of a hazardous substance) the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund (42 U.S.C. §§ 9601–9675), for instance, have federal agency compliance standards.

Executive Orders (EOs) are also used to establish requirements for federal agencies and may apply to federal contractors through the contract mechanism. Regulatory agreements and compliance orders may serve to clarify federal facility compliance requirements. In turn, requirements governing operations of Sandia National Laboratories/New Mexico (SNL/NM) arise from compliance with federal laws and regulations, applicable state laws and their regulatory permitting conditions, and federal agency oversight requirements such as by the application of DOE/National Nuclear Security Administration (NNSA) policies or EOs.

I.2 APPLICABLE FEDERAL LAWS AND REGULATIONS

This section describes the federal environmental, safety, and health laws and regulations that may apply to SNL/NM operations. These federal laws and regulations address such areas as resource protection, energy conservation, administrative requirements and procedures, nuclear safety, and classified information. Many of the major federal laws that apply to SNL/NM operations are identified in Table I-1. For ease of reference, federal laws are identified in Table I-1 with a U.S.C. or Public Law citation. EOs, DOE directives, and non-federal requirements are discussed separately in later sections.

Table I-1. Potentially Applicable Federal Laws and Regulations by Topic

Public Laws and Regulations	Topic	Citation	Responsible Agency	Description
Atomic Energy Act	Management of Nuclear Materials and Radioactive Waste	42 U.S.C. § 2011 et seq.	DOE; U.S. Nuclear Regulatory Commission (NRC)	Governs the development and control of atomic energy for civilian and military purposes. Ensures the proper management of certain nuclear materials and radioactive waste.
DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980	Management of Nuclear Materials and Radioactive Waste	Pub. Law No. 96-164, 93 Stat. 1259 (1979)	DOE	Mandated the DOE Secretary enter into a “consultation and cooperation” agreement with the State of New Mexico in carrying out construction of Waste Isolation Pilot Plant (WIPP) and disposal of radioactive waste. Also expressed Congressional intent regarding the management of national weapons laboratories, and renamed the Sandia Laboratories at Albuquerque, New Mexico, and Livermore, California, as the “Sandia National Laboratories.”
Low-Level Radioactive Waste Policy Act	Management of Nuclear Materials and Radioactive Waste	42 U.S.C. § 2021b et seq.	DOE	Provides that the federal government is responsible for disposal of low-level radioactive waste (LLW) generated by certain activities, and that each state is responsible for disposal of other LLW generated within its borders.
Energy Policy Act of 2005, as amended	Energy Efficiency and Security	Pub. Law No. 109-58, 119 Stat. 594 (2005)	DOE	Signed into law by President George W. Bush at SNL/NM on August 8, 2005. Directed, among other things, implementation of a wide range of energy research, development, and demonstration programs intended to increase energy efficiency and conservation, promote a diverse energy supply, foster U.S. energy independence and security, and decrease the environmental impact of energy-related activities.
National Forest Management Act of 1976	Ecological Resources	16 U.S.C. §§ 1600–1614	U.S. Department of Agriculture Forest Service (Forest Service)	Establishes standards for how the Forest Service manages the national forests and requires the development of land management plans for national forests and grasslands.

Public Laws and Regulations	Topic	Citation	Responsible Agency	Description
Bald and Golden Eagle Protection Act	Ecological Resources	16 U.S.C. §§ 668–668d	U.S. Fish and Wildlife Service (USFWS)	Prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" eagles, including their parts, nests, or eggs.
Endangered Species Act	Ecological Resources	16 U.S.C. §§ 1531–1544	USFWS	Provides a framework to conserve and protect endangered and threatened species and their habitats.
Migratory Bird Treaty Act	Ecological Resources	16 U.S.C. §§ 703–712	USFWS	Makes it unlawful without a waiver to pursue, hunt, take, capture, kill, or sell protected migratory birds.
American Indian Religious Freedom Act	Cultural and Paleontological Resources	42 U.S.C. § 1996	All Federal Departments and Agencies	Sets U.S. policy to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise their traditional religions, including access to sites, possession of sacred objects, and freedom to worship.
Archaeological and Historic Preservation Act	Cultural and Paleontological Resources	54 U.S.C. §§ 312501–312508	Federal Agencies	Requires federal agencies to, among other things, preserve historic and archeological objects and materials that would otherwise be lost or destroyed as a result of their projects or licensed activities or programs.
Archaeological Resources Protection Act of 1979	Cultural and Paleontological Resources	16 U.S.C. §§ 470aa–470mm	Federal Agencies	Makes it a federal crime to excavate, remove, damage, alter, or otherwise deface archaeological resources on federal lands without authorization.
Federal Land Policy and Management Act	Cultural and Paleontological Resources	43 U.S.C. §§ 1701–1782	Bureau of Land Management (BLM)	Requires that public lands be managed in a manner that protects the quality of scientific and other values. Governs land exchanges with the federal government.
Native American Graves Protection and Repatriation Act	Cultural and Paleontological Resources	25 U.S.C. §§ 3001–3013	National Park Service (NPS); U.S. Department of the Interior (DOI)	Establishes rights for Native American tribes to claim ownership and repatriate human remains and funerary, sacred, and other objects controlled by federal agencies and museums.

Public Laws and Regulations	Topic	Citation	Responsible Agency	Description
National Historic Preservation Act	Cultural and Paleontological Resources	54 U.S.C. §300101 et seq.	Federal Agencies; Advisory Council on Historic Preservation (ACHP)	Requires Federal agencies to consider the potential effects of their undertakings, such as construction projects, on properties covered by the National Historic Preservation Act (NHPA), including historic properties, properties eligible for listing on the National Register of Historic Places (NRHP), or properties that an Indian Tribe regards as having religious or cultural importance. Affords ACHP a reasonable opportunity to comment on such undertakings.
Nuclear Safety Management	Worker Safety and Health	Title 10 of the <i>Code of Federal Regulations</i> (10 CFR) Part 830	DOE	Governs the conduct of DOE contractors, DOE personnel, and other persons conducting activities (including providing items and services) that affect, or may affect, the safety of DOE nuclear facilities.
Occupational Radiation Protection	Worker Safety and Health	10 CFR Part 835	DOE	Defines radiation protection standards, limits, and program requirements for protecting workers from ionizing radiation resulting from DOE activities.
Chronic Beryllium Disease Prevention Program	Worker Safety and Health	10 CFR Part 850	DOE	Established to reduce the number of workers exposed to beryllium in the course of their work at DOE facilities managed by DOE or its contractors; minimize the levels of, and potential for, exposure to beryllium; and establish medical surveillance requirements to ensure early detection of berylliosis.
Worker Health and Safety Program	Worker Safety and Health	10 CFR Part 851	DOE	Defines controls and monitoring of hazardous materials to prevent exposure to health hazards such as toxic chemicals, excessive noise, and ergonomic stressors.
Revision of NEPA Implementing Procedures, Interim Final Rule (90 FR 29676, July 3, 2025)	Environmental Impacts	10 CFR Part 1021	DOE	DOE interim final rule containing categorical exclusions and emergency procedures.
Floodplain Management	Water Resources	10 CFR Part 1022	DOE	Addresses concerns over the potential loss of the natural and beneficial functions of the floodplains. DOE has proposed to rescind 10 CFR 1022 (90 FR 20947, May 16, 2025).

Public Laws and Regulations	Topic	Citation	Responsible Agency	Description
Protection of Wetlands	Water Resources	10 CFR Part 1022	DOE	Avoidance of any short- or long-term adverse impacts on wetlands wherever there is a practicable alternative. DOE has proposed to rescind 10 CFR 1022 (90 FR 20947, May 16, 2025).
Occupational Safety and Health Act	Worker Safety and Health	29 U.S.C. §§ 651–678	Occupational Safety and Health Administration (OSHA)	Provides for worker and workplace safety, including a workplace free from recognized hazards, such as exposure to toxic chemicals, excessive noise levels, and mechanical dangers.
Hazardous Materials Transportation Act	Transportation	49 U.S.C. §§ 5101–5128	DOT	Governs the transportation of hazardous material in intrastate, interstate, and foreign commerce, and designates the U.S. Department of Transportation (DOT) to prescribe uniform national regulations for transporting hazardous materials (including radioactive materials).
Federal Aviation Act	Transportation	49 U.S.C. § 40101 et seq.	FAA	Governs civil aviation in the United States, including unmanned systems (UxS), air traffic control, certification of personnel and aircraft, and airport safety.
Comprehensive Environmental Response, Compensation, and Liability Act (also known as Superfund)	Emergency Planning, Pollution Prevention, and Remediation	42 U.S.C. §§ 9601–9675	EPA	Provides, among other things: (1) a program for emergency response to and reporting of a release or threat of a release of a hazardous substance to the environment, and (2) a statutory framework for remediation of hazardous substance releases from federal, state, and private sites.
Emergency Planning and Community Right-to-Know Act	Emergency Planning, Pollution Prevention, and Remediation	42 U.S.C. §§ 11001–11050	EPA	Also known as Superfund Amendments and Reauthorization Act (SARA) Title III; establishes emergency planning and reporting requirements for federal, state, and local governments and industry, including emergency plans, emergency notification, hazardous chemical storage reporting requirements, and toxic chemical release forms.
Pollution Prevention Act of 1990	Emergency Planning, Pollution Prevention, and Remediation	42 U.S.C. § 13101 et seq.	EPA	Directs owners or operators of facilities required to file annual toxic chemical release forms under SARA to include with each such filing a toxic chemical source reduction and recycling report.

Public Laws and Regulations	Topic	Citation	Responsible Agency	Description
Radiological Emergency Planning and Preparedness	Emergency Planning, Pollution Prevention, and Remediation	44 CFR Part 351	Federal Emergency Management Agency (FEMA) and other federal agencies	Sets out federal agency roles applicable to radiological accidents at fixed nuclear facilities and transportation accidents involving radioactive materials.
National Environmental Policy Act of 1969	Environmental Quality	42 U.S.C. § 4321 et seq.	All federal agencies	Establishes the requirement for federal agencies to prepare an environmental impact statement (EIS) for major federal actions significantly affecting the quality of the human environment.
Clean Air Act	Air Quality	42 U.S.C. § 7401 et seq.	EPA	Intended to protect public health and welfare by regulating air emissions from both stationary and mobile sources. Establishes national air quality standards, requires states to develop implementation plans to meet those standards, and mandates pollution controls for various sources.
Noise Control Act	Noise	42 U.S.C. § 4901 et seq.	EPA	Establishes the policy of the United States to promote an environment for Americans free from noise that jeopardizes health and welfare.
Clean Water Act	Water Resources	33 U.S.C. §§ 1251–1387	EPA	Intended to “restore and maintain the chemical, physical, and biological integrity of the Nation’s water.” Establishes the basic structure for regulating discharges of pollutants into the waters of the United States.
Safe Drinking Water Act	Water Resources	42 U.S.C. § 300(f) et seq.	EPA	Protects the quality of public drinking water supplies and sources. Authorizes EPA to set national standards for drinking water sources, treatment systems, and water distribution.
Energy Independence and Security Act of 2007	Water Resources	42 U.S.C. § 17001 et seq.	EPA	Promotes a range of U.S. energy efficiency, independence, and security measures, including the energy performance of the U.S. government. Contains (Section 438) stormwater runoff requirements for federal development projects and calls for federal development with a footprint that exceeds 5,000 square feet to maintain or restore pre-development hydrology.

Public Laws and Regulations	Topic	Citation	Responsible Agency	Description
Federal Facility Compliance Act of 1992	Hazardous Waste and Materials Management	42 U.S.C. §§ 6961, 6965	New Mexico Environment Department (NMED)	Amended Resource Conservation and Recovery Act (RCRA) to, among other things, make federal agencies subject to the same environmental laws and regulations regarding hazardous waste and solid waste as private parties.
Regulation of Underground Storage Tanks	Hazardous Waste and Materials Management	42 USC §§ 6991–6991	EPA	Provides for the oversight of underground storage tank programs.
Federal Insecticide, Fungicide, and Rodenticide Act	Hazardous Waste and Materials Management	7 U.S.C. §§ 136–136y	EPA	Requires all pesticides distributed or sold in the United States to be registered by EPA. Registered pesticides must be determined to “not generally cause unreasonable adverse effects on the environment.”
Resource Conservation and Recovery Act	Hazardous Waste and Materials Management	42 U.S.C. § 6901 et seq.	EPA	Governs the treatment, storage, and disposal of hazardous waste and non-hazardous waste (that is, municipal solid waste). Amendments to RCRA promulgated in 1984 (Hazardous and Solid Waste Amendments of 1984) primarily focus on minimizing hazardous waste generation, phasing out land disposal of untreated hazardous waste, and stricter management practices for hazardous waste.
Toxic Substances Control Act	Hazardous Waste and Materials Management	15 U.S.C. § 2601 et seq.	EPA	Governs the manufacture, processing, distribution, use, and disposal of specific chemical substances and/or mixtures (e.g., PCBs, asbestos, and other substances).
Energy Act of 2020	Energy Efficiency and Security	Pub. Law. No. 116-260, div. Z, Dec. 27, 2020, 134 Stat. 2418	Federal Agencies	Intended to advance energy efficiency and security, promote renewable energy, modernize the electric grid, and ensure the reliability of the nation's energy infrastructure. Reauthorizes and expands DOE research and development programs in areas like advanced nuclear, long-duration energy storage, and other technologies. Also requires federal agencies to install cost-effective energy and water conservation measures in their buildings and to implement energy efficiency measures.

I.3 EXECUTIVE ORDERS AND MEMORANDA

This section identifies environment-, health-, and safety-related EOs and memoranda potentially applicable to SNL/NM operations. Table I-2 lists applicable EOs and memoranda by topical area and is followed by a brief summary of each, organized by number.

Table I-2. Potentially Applicable Executive Orders

EO Number/FR Citation	Title	Responsible Agency	Topical Area	Description
11988	Floodplain Management	Federal Agencies	Ecological Resources	Requires federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts are avoided to the extent practicable.
13112	Invasive Species	DOI National Invasive Species Council	Ecological Resources	Directs federal agencies to take steps to prevent the introduction and spread of invasive species and to support efforts to eradicate and control invasive species that are already established.
13751	Safeguarding the Nation from the Impacts of Invasive Species	Federal Agencies	Ecological Resources	Amends EO 13112 and directs actions to continue coordinated federal prevention and control efforts related to invasive species.
13186	Responsibilities of Federal Agencies to Protect Migratory Birds	USFWS	Ecological Resources	Provides broad guidance to federal agencies regarding conservation responsibilities and directs each federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement, within 2 years, a Memorandum of Understanding with USFWS that shall promote the conservation of migratory bird populations.
11593	Protection and Enhancement of the Cultural Environment	DOI	Cultural and Paleontological Resources	Establishes a policy that the federal government will preserve, restore, and maintain the historic and cultural environment of the Nation. Directs federal agencies to administer the cultural properties under their control in a spirit of stewardship and trusteeship to preserve, restore, and maintain such properties for the inspiration and benefit of the American people, on the NRHP.
13007	Indian Sacred Sites	Federal Agencies	Cultural and Paleontological Resources	Directs each executive branch agency with statutory or administrative responsibility for the management of federal lands, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, to (1) accommodate access to and ceremonial use of American Indian sacred sites by their religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites.

EO Number/FR Citation	Title	Responsible Agency	Topical Area	Description
13287	Preserve America	ACHP and DOI	Cultural and Paleontological Resources	Establishes federal policy to advance the protection, enhancement, and contemporary use of the historic properties owned by the federal government and to promote intergovernmental cooperation and partnerships for the preservation and use of historic properties.
12699	Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction	Federal Agencies	Worker Safety and Health	Requires federal agencies to reduce risks to occupants of buildings owned, leased, or purchased by the federal government, or buildings constructed with federal assistance, and to persons who would be affected by failures of federal buildings in earthquakes; to improve the capability of existing federal buildings to function during or after an earthquake; and to reduce earthquake losses of public buildings.
12656	Assignment of Emergency Preparedness Responsibilities	National Security Council and Federal Agencies	Emergency Planning	Established a policy of the United States to have sufficient emergency response capabilities at all levels of government to meet essential defense and civilian needs during any national security emergency. Assigned a broad range of responsibilities to heads of federal agencies to be prepared to respond adequately to all national security emergencies, including development of plans, capability, training, and other measures. Also requires agency heads to ensure continuity of essential functions under national security emergency conditions.
12088	Federal Compliance with Pollution Control Standards	EPA	Pollution Prevention and Conservation	Directs federal agencies to comply with applicable administrative and procedural pollution control standards established by, but not limited to, CAA, the Noise Control Act, Clean Water Act, the Safe Drinking Water Act, TSCA, and RCRA; and coordinate with appropriate federal and state entities.
12580	Superfund Implementation	Federal Agencies	Pollution Prevention and Conservation	Delegates to federal departments and agencies the authority to implement certain provisions of CERCLA.
13327	Federal Real Property Management	Office of Management and Budget	Pollution Prevention and Conservation	Specifies that management requirements for historic property under EO 13287 and for environmental management under EO 13148, <i>Greening the Government through Leadership in Environmental Management</i> , be incorporated into all planning and management for federal real property.
13045	Protection of Children from Environmental Health Risks and Safety Risks	Federal Agencies	Environmental Justice and the Protection of Children	Requires each federal agency to give high priority to identifying and assessing environmental health risks and safety risks that may disproportionately affect children and to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

EO Number/FR Citation	Title	Responsible Agency	Topical Area	Description
11514	Protection and Enhancement of Environmental Quality	Federal Agencies	Environmental Quality	Requires federal agencies to monitor, evaluate and control activities to: (1) protect and enhance the quality of the environment, (2) develop programs and measures to protect and enhance environmental quality, (3) assess progress in meeting the specific objectives of such activities, and (4) develop procedures to ensure timely public information and understanding of federal plans and programs with environmental impact.
13175	Consultation and Coordination with Indian Tribal Governments	Federal Agencies	Government-to-Government Relationships with Tribal Governments	Supplemented by the April 29, 1994, Executive memorandum, <i>Government-to-Government Relations with Tribal Governments</i> . Stated purpose is to establish regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen U.S. government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes.
14299	Deploying Advanced Nuclear Reactor Technologies for National Security,	DOE and DoD	Development and Deployment of Advanced Nuclear Technologies	Accelerate the secure and responsible development, demonstration, deployment, and export of advanced nuclear technologies to bolster readiness and enhance American technological superiority.
14302	Reinvigorating the Nuclear Industrial Base	Federal Agencies	Production and Operation of Nuclear Energy	Ensure national and economic security by increasing nuclear fuel availability production, securing nuclear supply chains, improving the efficiency in licensing advance nuclear reactors, and preparing American workforce.

I.4 APPLICABLE DOE DIRECTIVES

Operation at SNL/NM complies with DOE and NNSA directives incorporated into the Management and Operations Contract. The DOE Directives System includes all current DOE orders, policies, manuals, requirement documents, notices, and guides related to DOE programs and operations. The major DOE directives potentially relevant to the operations and alternatives considered in this SWEIS are listed and briefly described in Table I-3.

Table I-3. Applicable DOE Directives

DOE Directive	Summary
DOE Policy 141.1, Department of Energy Management of Cultural Resources (May 2, 2001; Certified January 28, 2011)	Requires that DOE programs, including NNSA and field elements integrate cultural resources management into their missions and activities.
DOE Order 144.1A, Department of Energy American Indian Tribal Government Interactions and Policy (November 7, 2024)	Communicates departmental, programmatic, and field responsibilities for interacting with American Indian governments and transmits DOE's American Indian and Alaska Native Tribal Government Policy and its guiding principles, the Framework for Implementation of the Policy.
DOE Order 151.1E, Comprehensive Emergency Management System (October 28, 2024)	Establishes policy to assign and describe roles and responsibilities for the DOE Emergency Management System, which provides the framework for development, coordination, control, and direction of all emergency planning, preparedness, readiness assurance, response, and recovery actions. The Emergency Management System applies to DOE and to NNSA.
DOE Order 153.1A, Departmental Nuclear Emergency Support Team Capabilities (November 17, 2022)	Establishes requirements and responsibilities for DOE/NNSA national radiological emergency response assets and capabilities and Nuclear Emergency Support Team assets.
DOE Order 225.1B, Accident Investigations (March 4, 2011)	Prescribes organizational responsibilities, authorities, and requirements for conducting investigations of certain accidents occurring at DOE sites.
DOE Order 226.1B, Administrative Change 1, Implementation of Department of Energy Oversight Policy (May 3, 2022)	Implements the policy that establishes a DOE-wide oversight process to protect the public, workers, environment, and national security assets effectively through continuous improvement.
DOE Order 227.1, Administrative Change 1, Independent Oversight Program (January 21, 2020)	Prescribes the requirements and responsibilities for the DOE Independent Oversight Program.
DOE Order 231.1B, Administrative Change 1, <i>Environment, Safety and Health Reporting</i> (November 28, 2012)	Addresses DOE/NNSA receipt of timely, accurate information about events that have affected or could adversely affect the health, safety, and security of the public or workers; the environment; the operations of DOE facilities; or DOE credibility.
DOE Order 232.2A, Change 1 (Min Chg), Occurrence Reporting and Processing of Operations Information (October 4, 2019)	Promotes organizational learning consistent with DOE's Integrated Safety Management System goal of enhancing mission safety and sharing effective practices to support continuous improvement and adaptation to change.
DOE Order 410.2, Administrative Change 1, <i>Management of Nuclear Materials</i> (April 10, 2014)	Establishes requirements for the lifecycle management of DOE-owned and/or managed accountable nuclear materials.

DOE Directive	Summary
DOE Order 413.3B, Change 7, Program and Project Management for the Acquisition of Capital Assets (June 21, 2023)	Provides DOE elements, including NNSA, with program and project management direction for the acquisition of capital assets, with the goal of delivering projects within the original performance baseline, cost, and schedule that are fully capable of meeting mission performance; safeguards and security; and environmental, safety, and health requirements unless impacted by a directed change.
DOE Order 414.1E, <i>Quality Assurance</i> (December 18, 2024)	Ensures that DOE, including NNSA, products and services meet or exceed customers' requirements and expectations.
DOE Policy 420.1, Department of Energy Nuclear Safety Policy (February 8, 2011)	Documents DOE's nuclear safety policy.
DOE Order 420.1C, Change 3 (Ltd Chg), <i>Facility Safety</i> (November 14, 2019)	Establishes facility and programmatic safety requirements for nuclear and explosives safety design criteria, fire protection, criticality safety, natural phenomena hazards mitigation, and the System Engineer Program. Change 3 cancels DOE Order 5480.30, <i>Nuclear Reactor Safety Design Criteria</i> , and adds a section on the topic to Attachment 3.
DOE Order 420.2D, <i>Safety of Accelerators</i> (September 9, 2022)	Defines accelerators and establishes accelerator-specific safety requirements and approval authorities that, when supplemented by other applicable safety and health requirements, promote safe operations to ensure protection of workers, the public, and the environment. Supersedes/cancels DOE Order 420.2C.
DOE Order 422.1, Change 4 (Ltd Chg), <i>Conduct of Operations</i> (February 3, 2022)	Defines the requirements for establishing and implementing Conduct of Operations Programs for DOE/NNSA facilities and projects.
DOE Order 425.1E, Verification of Readiness to Start Up or Restart Nuclear Facilities (September 25, 2024)	Establishes requirements for verifying readiness for startup of new Hazard Category (HC)-1, HC-2, and HC-3 nuclear facilities, activities, and operations, as well as for restart of existing HC-1, HC-2, and HC-3 nuclear facilities, activities, and operations that have been shut down. Change 2 clarifies that the order does not invoke Technical Standards.
DOE Order 426.2A, Change 1 (Adm Chg), Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities (May 30, 2024)	Establishes selection, training, qualification, and certification requirements for contractor personnel who can impact the safety basis through their involvement in the operation, maintenance, and technical support of HC-1, HC-2, and HC-3 nuclear facilities.
NNSA SD 430.1, dated January 15, 2020, established to implement DOE O 430.1C, <i>Real Property Asset Management</i> (September 17, 2020)	Establishes a data-driven, risk-informed, performance-based approach to the lifecycle management of real property assets that aligns the real property portfolio with DOE mission needs; acquires, manages, positively accounts for, and disposes of real property assets in a safe, secure, cost-effective, and sustainable manner; and ensures the real property portfolio is appropriately sized, aligned, and in the proper condition to support efficient mission execution.
DOE Order 433.1B, Change 1, Maintenance Management Program for DOE Nuclear Facilities (March 12, 2013)	Defines the safety management program required by 10 CFR 830.204(b)(5) for maintenance and the reliable performance of structures, systems, and components that are part of the safety basis required by 10 CFR 830.202 at HC-1, HC-2 and HC-3 DOE nuclear facilities.
DOE Order 435.1, Change 2 (Adm Chg), <i>Radioactive Waste Management</i> (January 11, 2021)	Ensures that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety and the environment.

DOE Directive	Summary
DOE Manual 435.1-1, <i>Radioactive Waste Management Manual</i> (January 11, 2021)	Describes the requirements and establishes specific responsibilities for implementing DOE Order 435.1, <i>Radioactive Waste Management</i> , for the management of DOE high-level waste, transuranic (TRU) waste, LLW, and the radioactive component of mixed waste. The purpose of the manual is to catalog those procedural requirements and existing practices that ensure that all DOE elements and contractors continue to manage DOE's radioactive waste in a manner that is protective of worker and public health and safety, and the environment.
DOE Order 440.1B, Administrative Change 4, Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees (May 2, 2022)	Establishes the framework for DOE's worker protection program to reduce or prevent injuries, illnesses, and accidental losses.
DOE Guide 441.1-1C, Change 1, Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection (July 8, 2011)	Provides guidance for implementing the provisions of 10 CFR Part 835.
DOE Order 452.1F, Nuclear Explosive and Weapon Surety Program (January 22, 2023)	Provides requirements and responsibilities to prevent unintended/unauthorized detonation and deliberate unauthorized use of nuclear explosives. Cancels DOE Order 452.1E.
DOE Order 452.2F, <i>Nuclear Explosive Safety</i> (July 27, 2020)	Establishes requirements to implement the nuclear explosive safety elements of DOE Order 452.2E, <i>Nuclear Explosive and Weapon Surety Program</i> , for routine and planned nuclear explosive operations.
DOE Order 452.3, Management of the Department of Energy Nuclear Weapons Complex (June 8, 2005)	Defines and affirms the authorities and responsibilities of NNSA for management of the DOE nuclear weapons complex and emphasizes that management of the United States' nuclear weapons stockpile is DOE's highest priority for NNSA and the DOE nuclear weapons complex.
DOE Order 456.1A, The Safe Handling of Unbound Engineered Nanoparticles (July 15, 2016)	Establishes requirements and assigns responsibilities for DOE/NNSA for activities involving unbound engineered nanoparticles.
DOE Order 457.1A, <i>Nuclear Counterterrorism</i> (August 26, 2013)	Defines requirements for protection of sensitive improvised nuclear device information and provides a framework to support DOE activities related to nuclear counterterrorism.
DOE Order 458.1, Chg 5, Admin Chg, <i>Radiation Protection of the Public and the Environment</i> (January 30, 2025)	Establishes requirements to protect the public and the environment against undue risk from radiation associated with radiological activities conducted under the control of DOE, pursuant to the Atomic Energy Act of 1954.
DOE Order 460.1D, Change 1, <i>Hazardous Materials Packaging and Transportation Safety</i> (June 10, 2022)	Establishes safety requirements for proper packaging and transportation of offsite shipments and onsite transfers of hazardous materials, including radioactive materials.
DOE Order 460.2B, <i>Departmental Materials Transportation Management</i> (June 10, 2022)	Establishes requirements and responsibilities for management of DOE/NNSA materials transportation to ensure the safe, secure, efficient packaging and transportation of materials, both hazardous and non-hazardous, for offsite shipments.

DOE Directive	Summary
DOE Order 461.1C, Change 1 (Min Chg), Packaging and Transportation for Offsite Shipment of Materials of National Security Interest (October 4, 2019)	Makes clear that the packaging and transportation of all offsite shipments of materials of national security interest for DOE must be conducted in accordance with the DOT and NRC regulations that would be applicable to comparable commercial shipments, except where an alternative course of action is identified in this order. The order was updated to clarify which Technical Standards are invoked.
DOE Order 461.2, Onsite Packaging and Transfer of Materials of National Security Interest (November 1, 2010)	Prescribes requirements and responsibilities for identifying and mitigating undue risk of onsite transfers that are noncompliant with DOT and NRC regulations.
DOE Order 462.1, Administrative Change 1, Import and Export of Category 1 and 2 Radioactive Sources and Aggregated Quantities (July 10, 2013)	Provides requirements and responsibilities pertaining to the International Atomic Energy Agency CODEOC/2004, <i>Code of Conduct on the Safety and Security of Radioactive Sources</i> .
DOE Order 471.1B, Identification and Protection of Unclassified Controlled Nuclear Information (March 1, 2010)	Provides requirements and responsibilities for identifying and protecting the unauthorized dissemination of Unclassified Controlled Nuclear Information.
DOE Order 471.7, <i>Controlled Unclassified Information</i> (February 3, 2022)	Establishes DOE’s Controlled Unclassified Information (CUI) Program and documents a policy for designating and handling information that qualifies as CUI. Cancels DOE Order 471.3, Change 1, and DOE Manual 471.3-1, Change 1.

I.5 STATE OF NEW MEXICO LAWS, REGULATIONS, AND AGREEMENTS

DOE/NNSA and SNL/NM personnel consider potential environmental impacts governed by state requirements applicable to SNL/NM when assessing continued operations and the identified alternatives. It is DOE policy to conduct its operations in an environmentally safe manner that complies with all statutes, regulations, and policies, including applicable state laws and regulations.

When enacted in 1978, New Mexico Statutes Annotated (NMSA) established, among other things, state environmental programs. These statutes are general in nature and set the bounds of authority for specific agencies, including NMED, and define departmental duties and responsibilities. *New Mexico Administrative Code* (NMAC) contains the state rules that implement specific laws enacted by state legislation (statutes). Although some of the implementing requirements are not applicable to SNL/NM operations, NNSA has considered relevant requirements to inform the assessment in this SWEIS.

I.5.1 State and Local Requirements and Agreements

Table I-4 lists state and local standards that may apply to or be relevant in certain circumstances for the continued operations at SNL/NM.

Table I-4. State and Local Standards

Title or Citation	Authority	Description
ABCWUA Ordinance Section 3, Sewer Use and Wastewater Control	Local Ordinance	Sets forth uniform requirements (including permitting) for all users of the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) Publicly Owned Treatment Works.
Federal Facility Compliance Order; October 4, 1995; NMED, DOE, and SNL/NM	Multiple-Party Agreement	Developed pursuant to the Federal Facility Compliance Act and entered into on October 4, 1995, by NMED, DOE, and Sandia Corporation to provide for compliance with 40 CFR 268.50 for mixed hazardous/radioactive waste at SNL/NM facilities.
Compliance Order on Consent; April 29, 2004; NMED, DOE, and SNL/NM	Multiple-Party Agreement	Contains investigation and corrective action requirements for SNL/NM, primarily by providing schedules and deliverables for corrective action pursuant to the New Mexico Hazardous Waste Act and the New Mexico Solid Waste Act. Does not apply to radionuclides, including, but not limited to, source material, special nuclear material, or byproduct material as defined in the Atomic Energy Act of 1954, or the radioactive portion of mixed waste. Does apply, however, to the hazardous waste component of mixed waste.
NMSA Chapter 17, Article 6, (Habitat Protection Act) Sections 17-6-1 through 17-6-11	State Law	Authorizes the State Game Commission to prohibit the use of vehicles in certain areas, with the concurrence of the private landowner or land management agency, if the operation of vehicles becomes damaging to wildlife reproduction, management, or habitat.
NMSA Chapter 72, Article 1, Section 72-1-10 (Water Utility Authority)	State Law	Grants ABCWUA the power to set policy and regulate, supervise, and administer the water and wastewater utility of Albuquerque and Bernalillo County.
NMSA Chapter 74, Article 1, Sections 74-1-12 and 74-1-13 (revised October 31, 2002) (Environmental Improvement Act)	State Law	Establishes an incentive for water conservation and a state program to foster compliance with the federal Safe Drinking Water Act.
NMSA Chapter 74, Air Pollution (revised October 31, 2002), Sections 74-2-1 through 74-2-22 (Air Quality Control Act)	State Law	Establishes air quality standards for the State of New Mexico, designating the New Mexico Air Quality Bureau as the state air pollution control authority; allows for the acquisition of jurisdiction for air pollution control, by a local authority (city or county).
NMSA Chapter 74, Article 4, Hazardous Waste (revised June 14, 2000), Sections 74-4-1 through 74-4-14 (Hazardous Waste Act)	State Law	Establishes a permit requirement for construction, operation, modification, and closure of a hazardous waste management facility and establishes state standards for cleanup of releases from leaking underground storage tanks.
NMSA Chapter 74, Article 6, Water Quality, 1978, Sections 74-6-1 through 74-6-17 (Water Quality Act)	State Law	Establishes water quality standards and requires a permit prior to the construction or modification of a water discharge source.
NMSA Chapter 75, Article 6, Part 1 (Endangered Plants)	State Law	Directs the natural resources department to investigate all species of plants, defines endangered plant species, and establishes a program and protections for the conservation of listed endangered plant species.

Title or Citation	Authority	Description
NMSA Chapter 76, Article 8 (Protection of Native New Mexico Plants) Sections 76-6-1 through 76-8-4	State Law	Enumerates protected plants, removal prohibitions, exception, and penalties.
NMAC Title 20, Chapter 11 (revised 5/13/2013)	State Regulation	Provides implementing regulations for the Albuquerque-Bernalillo County Air Quality Program with the Albuquerque-Bernalillo County Air Quality Control Board.
NMAC Title 20, Chapter 4, Part 1 Hazardous Waste Management (revised 12/1/2018),	State Regulation	Provides implementing regulations covering hazardous waste identification and management.
NMAC Title 20, Chapter 9 (revised 8/2/2007), Part 6, Ground Water Protection (effective 1/31/2011)	State Regulation	Provides implementing regulations covering solid waste requirements.

I.5.2 State and Local Permits

NNSA and SNL/NM operate under a number of permits issued by the State of New Mexico, County of Bernalillo, City of Albuquerque, EPA, and USFWS. Included are, among other things, permits for hazardous waste management, air quality (stationary source, open burn, and fugitive dust control permits), water quality and discharge permits (wastewater and stormwater), and ecological monitoring. For a list of these permits and summary information about them, refer to the most current SNL/NM Annual Site Environmental Report, which is available online at: <https://www.sandia.gov/news/publications/environmental-reports/>.

APPENDIX J

ACRONYMS AND GLOSSARY

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Appendix J – Acronyms and Glossary

J.1 ACRONYMS AND ABBREVIATIONS

ABC	Albuquerque & Bernalillo County
ABCWUA	Albuquerque Bernalillo County Water Utility Authority
AC	Advisory Circular
ACHP	Advisory Council on Historic Preservation
ACM	asbestos-containing material
ACRR	Annular Core Research Reactor
ADT	average daily traffic
AHCU	Auxiliary Hot Cell Unit
ALARA	as low as reasonably achievable
AOC	area of concern
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ASER	Annual Site Environmental Report
ASGARD	Advanced Solar Generation and Resiliency Deployment
ATWIR	Annual TRU Waste Inventory Report
avg.	average
BEA	Bureau of Economic Analysis
BBCS	Bird and Bat Conservation Strategy
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BMP	best management practice
BSL	biosafety level
C&D	construction and demolition
CAA	Clean Air Act
CAM	Classified Advanced Manufacturing
CAMINO	Center for Advanced Manufacturing and Innovation
CAP88-PC	CAA Assessment Package – Personal Computer
CERL	Cyber Engineering Research Laboratory
CETF	Consolidated Environmental Test Facility
CFR	Code of Federal Regulations
CGP	construction general permit
CGSC	Center for Global Security and Cooperation
CH ₄	methane
CHESTNUT	Conventional High Explosive SimulaTed Nuclear Test
Ci	curie
Ci/yr	curie per year
CINT	Center for Integrated Nanotechnologies
CNF	Cibola National Forest
CO	carbon monoxide
CO ₂	carbon dioxide
CO _{2e}	carbon dioxide equivalent
COA	certificate of authorization

CREST	Combined Radiation Environments for Survivability Testing
CSAC	Computer Security Analysis Center
CSP	concentrating solar power
CSRI	Computer Science Research Institute
CSW	commercial solid waste
CTF	Coyote Test Field
CUB	Central Utility Building
CUI	Controlled Unclassified Information
CWA	Clean Water Act
CWL	Chemical Waste Landfill
CZ	Clear Zone
DAF	Department of the Air Force
DART	Days Away, Restricted, or Transferred
dB	decibel (noise)
dBA	A-weighted decibel (noise)
DBA	design-basis accident
DD&D	decontamination, decommissioning, and demolition
DNFSB	Defense Nuclear Facilities Safety Board
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOECAP	Department of Energy Consolidated Audit Program
DOT	U.S. Department of Transportation
DSA	documented safety analysis
DSSI	Diversified Scientific Services, Inc.
EA	environmental assessment
ECIL	Engineering Computation & Information Laboratory
EDAF	Engineering Data Analytics Facility
EHD	(Albuquerque) Environmental Health Department
EIS	environmental impact statement
EISA	Energy Independence and Security Act
ELP	extended life program
EM	DOE Office of Environmental Management
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPHA	emergency planning hazards assessment
ER	environmental restoration
ERP	Environmental Restoration Program
ERRRT	Environmental Release Response & Reporting Team
ES&H	environment, safety, and health
ESA	Endangered Species Act
EV	electric vehicle
EXP	Expanded Operations Alternative
FAA	Federal Aviation Administration
FACT	Facility for Acceptance, Calibration & Testing
FARM	Facility for Antenna and Radar Cross-Section Measurements
FEMA	Federal Emergency Management Agency

FFCO	Federal Facility Compliance Order
FFRDC	Federally Funded Research and Development Center
FONSI	finding of no significant impact
Forest Service	U.S. Department of Agriculture, Forest Service
FR	Federal Register
ft ²	square feet
ft ³	cubic feet
ft-bgs	feet below ground surface
FY	fiscal year
G3P3	Generation 3 Particle Pilot Plant
gal	gallons
gal/yr	gallons per year
GHG	greenhouse gas
GIF	Gamma Irradiation Facility
HAP	hazardous air pollutant
HC	Hazard Category
HEPA	high-efficiency particulate air
HERMES	High Energy Radiation Megavolt Electron Source III
HVAC	heating, ventilation, and air conditioning
HWHU	Hazardous Waste Handling Unit
Hz	hertz
ICRMP	Integrated Cultural Resources Management Plan
IDA	intentional destructive act
INCRMP	Integrated Natural and Cultural Resources Management Plan
INL	Idaho National Laboratory
INRMP	Integrated Natural Resources Management Plan
IPaC	Information for Planning and Consultation
IPOC	Innovation Parkway Office Center
ips	inches per second
KAFB	Kirtland Air Force Base
kg	kilogram
km	kilometer
kV	kilovolt
kW-hr	kilowatt-hour
LANL	Los Alamos National Laboratory
LAZAP	Laser Application
LCF	latent cancer fatality
LEED	Leadership in Energy and Environmental Design
LEP	life extension program
LIHE	Light-Initiated High Explosive
LLNL	Lawrence Livermore National Laboratory
LLW	low-level radioactive waste
LOS	level of service
LTMMP	Long-Term Monitoring and Maintenance Plan
M	magnitude
m ³	cubic meter(s)

M&O	Management and Operating
MAR	material at risk
MBTA	Migratory Bird Treaty Act
MC2	Microelectronics Components Capability
MEI	maximally exposed individual
MESA	Microsystems Engineering, Science and Applications
mgd	millions of gallons per day
mi ²	square mile
MLLW	mixed low-level radioactive waste
MNSF2	Modular National Security Facility 2
MOD	Modernized Operations Alternative
MOI	maximally exposed offsite individual
mph	miles per hour
mrem	millirem (one-thousandth of a rem (0.001 rem))
MS4	Municipal Separate Storm Sewer System
MSB	Manzano Storage Bunker
MSGP	Multi-Sector General Permit
MT	metric ton
MTCO _{2e}	metric tons of carbon dioxide-equivalent
MTRU	mixed transuranic
MW	megawatts
MWe	megawatts electric
MWh	megawatt hour
MWL	Mixed Waste Landfill
N/A	not applicable
N ₂ O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NCI	National Cancer Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERF	NEST Emergency Response Facility
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NEST	Nuclear Emergency Search Team
New Mexico SHPO	New Mexico State Historic Preservation Office
NGE+	Neutron Generator Enterprise+
NGPP	Next Generation Pulsed-Power
NH ₃	ammonia
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NMAC	New Mexico Administrative Code
NMDGF	New Mexico Department of Game and Fish
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMHPD	New Mexico Historic Preservation Division
NMSW	New Mexico Special Waste
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Sites

NOI	notice of intent
NO _x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NSTTF	National Solar Thermal Test Facility
NTESS	National Technology & Engineering Solutions of Sandia, LLC
OB/OD	open burning/open detonation
OSHA	Occupational Safety and Health Administration
OST	Office of Secure Transportation
PAL	plant-wide applicability limit\
PCB	polychlorinated biphenyl
PGA	peak ground acceleration
PM	particulate matter
PM _{2.5}	particulate matter 10 micrometers or less in diameter
PM ₁₀	particulate matter 2.5 micrometers or less in diameter
PNM	Public Service Company of New Mexico
PSA	Physical Security Agile/Flex
PSEL	Photovoltaic Systems Evaluation Laboratory
PSHA	probabilistic seismic hazard analysis
PSL	Primary Standards Laboratory
Pu-239	plutonium-239
Pu-ICE	Plutonium Isentropic Compression Experiment
PV	photovoltaic
R&D	research and development
RACM	Regulated Asbestos Containing Materials
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RF	radiofrequency
RIMS II	Regional Input-Output Modeling System
RMWMU	Radioactive and Mixed Waste Management Unit
ROD	record of decision
ROI	Region of Influence
RVR	Robotic Vehicle Range
SA	supplement analysis
SAAQS	state ambient air quality standards
SAGE	Secure and Adaptable Grid Engineering
SD	Supplemental Directive
SDC	seismic design category
SF ₆	sulfur hexafluoride
SFO	Sandia Field Office
SGCN	Species of Greatest Conservation Need
SIID	SNL Infrastructure Investment Database
SIPS2D	Sound Intensity Prediction System Two-Dimensional

SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories/New Mexico
SNM	special nuclear material
SO ₂	sulfur dioxide
SPCC	spill prevention control and countermeasure
SPEIS	supplemental programmatic environmental impact statement
SPR	Sandia Pulsed Reactor
SPR/CX	Sandia Pulsed Reactor/Criticality Experiments
SSMP	Stockpile Stewardship and Management Program
SSTP	Sandia Science and Technology Park
STAR	Shock Thermodynamics Applied Research Facility
STARCOM	Strategic Training and Readiness Command
START	Sandia Tomography and Radionuclide Transport
STP	site treatment plan
Sunport	Albuquerque International Sunport
SWCRC	Solid Waste Collection and Recycling Center
SWMU	solid waste management unit
SWEIS	site-wide environmental impact statement
SWPPP	stormwater pollution prevention plan
TA	Technical Area
TAGC	Tijeras Arroyo Golf Course
TCP	Traditional Cultural Place
TCR 3&4	Test Capabilities Revitalization Phases 3 and 4
TLV	Threshold Limit Value
tpy	tons per year
TQ	threshold quantity
TRC	Total Recordable Case
TRU	transuranic
TSD	treatment, storage, and disposal
TSDF	treatment, storage, and disposal facility
TTU	Thermal Treatment Unit
U.S.	United States
U.S.C.	United States Code
UAS	unmanned aircraft system
UGS	unmanned ground system
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USV	unmanned surface vessel(s)
UUV	unmanned underwater vessel(s)
UxS	unmanned system(s)
VOC	volatile organic compound
VRM	Visual Resource Management
VTR	Vault-Type Room
WAPA	Western Area Power Administration
WIPP	Waste Isolation Pilot Plant

WMD	weapon of mass destruction
yr	year

CONVERSION CHART

TO CONVERT FROM U.S. CUSTOMARY INTO METRIC			TO CONVERT FROM METRIC INTO U.S. CUSTOMARY		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length					
inches	2.540	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.03281	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.6214	miles
Area					
square inches	6.452	square centimeters	square centimeters	0.1550	square inches
square feet	0.09290	square meters	square meters	10.76	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.4047	hectares	hectares	2.471	acres
square miles	2.590	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.57	milliliters	milliliters	0.03381	fluid ounces
gallon	3.785	liters	liters	0.2642	gallon
cubic feet	0.02832	cubic meters	cubic meters	35.31	cubic feet
cubic yards	0.7646	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.35	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.205	pounds
short tons	0.9072	metric tons	metric tons	1.102	short tons
Temperature					

Fahrenheit (°F)	subtract 32, then multiply by 5/9	Celsius (°C)	Celsius (°C)	multiply by 9/5, then add 32	Fahrenheit (°F)
Kelvin (K)	subtract 273.15	Celsius (°C)	Celsius (°C)	add 273.15	Kelvin (K)

Note: 1 sievert = 100 rems

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^9
mega-	M	1,000,000 = 10^6
kilo-	k	1,000 = 10^3
deca-	D	10 = 10^1
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	μ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}

J.2 GLOSSARY

This glossary includes terms used in the *Site-Wide Environmental Impact Statement for Continued Operation of Sandia National Laboratories, New Mexico* (DOE/EIS-0556) (SNL/NM SWEIS) that may not be familiar to some readers or that may have unique definitions because of the operations and alternatives considered. Multiple sources were consulted in developing this glossary, including the U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA), Sandia National Laboratories/New Mexico (SNL/NM), U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (EPA), and appropriate regulatory sources.

Accelerator: A device that accelerates the motion of charged particles (e.g., electrons, protons, atomic nuclei) to high velocities, thus giving them high kinetic energies. The accelerated particles may be used in industrial and medical applications or in research on nuclear or subnuclear phenomena.

Accident: An unplanned event or sequence of events that results in undesirable consequences.

Acoustic: Containing, producing, carrying, arising from, actuated by, related to, or associated with sound.

Activation product: Radionuclide formed by bombardment and adsorption in material with neutrons, protons, or other nuclear particles. For example, cobalt-60 is an activation product resulting from neutron activation of cobalt-59.

Action level: The level of pollutants, as defined by regulatory agencies, that if exceeded, requires regulatory action.

Acute exposure: A single, short-term exposure to radiation, chemicals, toxic substances, or other physical stressors (e.g., noise, vibration) that may result in biological harm. In the context of radiation, acute exposure refers to the absorption or intake of a significant amount of radiation or radioactive material over a brief period, typically occurring during and shortly after a radiological release. This type of exposure can lead to immediate health effects.

Acute Exposure Guideline Level (AEGL): The airborne concentration levels (expressed as parts per million or milligrams per cubic meter) that are used by emergency responders when dealing with chemical spills or other catastrophic exposures. AEGLs indicate the exposure levels above which it is predicted that the general population would experience adverse health effects, such as irreversible or other serious, long-lasting adverse health effects.

Advanced manufacturing technology: The science or study of the technology associated with the design, fabrication, theory, and application of manufacturing that uses prototype research and development of new technologies.

Advanced material: An advanced material is both new and/or modified from existing materials specifically designed to possess new or improved technical properties (structural or functional) or environmental features compared to materials traditionally used to perform the same functions.

Aerosol: A gaseous suspension of very small particles of liquid or solid.

Air dispersion modeling: A mathematical simulation, usually computer generated, of how gases, vapors, or particles disperse into the air.

Air pollutant: An airborne substance, including solid particles, liquid droplets, or gases, that could, in high enough concentrations, harm human health, the environment, or property. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated or for which maximum guideline levels have been established due to the pollutant's potential harmful effects.

Air quality: The quality of the air within a specific area, as determined by the presence and concentration of specific designated pollutants, such as particulate matter (PM), gases (e.g., carbon monoxide, sulfur dioxide, nitrogen oxides, ozone), and/or biological contaminants. Air quality is assessed based on its impact on human health, the environment, and overall ecosystem integrity. It is measured against established standards and guidelines to evaluate safety, in the context of compliance with applicable regulatory requirements.

Air Quality Control Region: Geographic subdivisions of the United States established to regulate pollution on a regional or local level. Some regions span more than one state.

Airborne release fraction (ARF): The coefficient used to estimate the amount of radioactive material that can be suspended in air and made available for airborne transport under a specific set of induced physical stresses. The ARF is used, along with other factors, to determine the source term for an accident or event.

Alluvial fan: A fan-shaped accumulation of sediment deposited by flowing water, marking the place where a stream moves from a steep slope to a flatter slope, causing a decrease in velocity and the subsequent deposition of sediment. Alluvial fans are typically composed of a variety of materials, including clay, silt, sand, and gravel, and they can vary in size and shape. These features can play a role in groundwater recharge and agriculture and as habitats for plant and animal species.

Alluvium: A sedimentary deposit of soil (i.e., clay, silt, sand) or rocks by flowing water, typically seen in river or creek beds, floodplains, and deltas.

Alpha radiation: Ionizing radiation consisting of alpha particles (two protons and two neutrons bound together) emitted by a substance undergoing radioactive decay.

Ambient air: Any unconfined portion of atmospheric air: open air, surrounding air. Ambient air is that portion of the atmosphere, external to buildings, to which the public has access.

Ambient air quality standard: Regulations prescribing the levels of airborne pollutants that may not be exceeded during a specified time within a defined area (refer to National Ambient Air Quality Standards [NAAQS]).

Ambient noise: The residual background sound in an environment that is absent of specific identifiable noise sources.

Aquifer: A body of rock or sediment under the Earth's surface that is capable of transmitting groundwater and yielding usable amounts of groundwater to supply wells and springs. An aquifer is a saturated geologic unit through which significant quantities of water can migrate under natural hydraulic gradients.

Archaeological site: A location that contains the physical evidence of past human behavior that allows for its interpretation.

Area of Concern: Any area that may have had a release of hazardous waste or hazardous constituents which is not a solid waste management unit.

Arroyo: A term applied in the arid and semi-arid southwestern United States to a small, deep, flat-floored channel or gully of an ephemeral or intermittent stream.

Artifact: An object produced or shaped by human workmanship that is of archaeological or historical interest.

As low as reasonably achievable (ALARA): A safety principle for radiation protection to manage and reduce exposures (both individual and collective) and releases of radioactive material to the environment to as far below applicable limits as social, technical, economic, practical, and public policy considerations permit. ALARA is not a limit but a process for minimizing doses to as far below limits as is practicable.

Asphyxiant: A substance that can cause suffocation or a decrease of oxygen in the body, leading to impaired respiratory function. This can occur either due to the substance displacing oxygen in the air or interference with the body's ability to utilize oxygen.

Atmospheric dispersion: The process by which airborne pollutants, gases, or particles are spread and diluted in the atmosphere due to various factors, including wind, temperature, humidity, and turbulence. This phenomenon affects how pollutants travel from their source and can influence their concentration and potential impact on air quality and human health. Atmospheric dispersion models are often used in environmental assessments (EAs) to predict the distribution and concentration of pollutants over time and distance, aiding in regulatory compliance and risk management.

Attainment area: An area that EPA has designated as being in compliance with one or more of the NAAQS for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and PM. An area may be in attainment for some pollutants but not for others.

Background radiation: Radiation from (1) cosmic sources; (2) decay of naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material [SNM]); and (3) global fallout from nuclear weapons as it exists in the environment (e.g., from the testing of nuclear explosive devices).

Baseline: A minimum or starting point used for comparisons. For this SWEIS, the existing resource area baseline condition is used to compare the Proposed Action alternatives impacts.

Best management practice (BMP): A method/practice or combination of methods/practices used to protect human health and the environment. A BMP is the most effective and practical means to protect people and control pollutants that are compatible with the productive use of the resource to which it is applied. BMPs can include but are not limited to schedules of activities; prohibitions of practices; maintenance procedures; treatment requirements; operating procedures; and practices to control runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Beryllium: A toxic and extremely lightweight element with the atomic number 4. Beryllium is metallic and used in reactors as a neutron reflector.

Beta radiation: Ionizing radiation consisting of fast-moving, positively or negatively charged elementary particles emitted from atomic nuclei during radioactive decay. Beta radiation is more penetrating but less ionizing than alpha radiation. Negatively charged beta particles are identical to electrons; positively charged beta particles are known as positrons.

Biological province: A continuous geographic area that possesses animal life distinguishable, at the species and subspecies levels, from the animal life of adjacent areas.

Biological resource: Any living organism or biological material, including plants, animals, fungi, and microorganisms, as well as genetic material and ecosystems.

Block group: A basic unit of estimated population used by the U.S. Census Bureau to define the demographics of an area.

Blocks: The smallest geographic area for which the U.S. Census Bureau collects and tabulates decennial census data. They are formed by streets, roads, railroads, streams and other bodies of water, other visible physical and cultural features, and the legal boundaries shown on Census Bureau maps.

Bound, bounding: To use simplifying assumptions and analytical methods in an analysis of impacts or risks such that the result overestimates or describes an upper limit on (i.e., *bounds*) potential impacts or risks. A *bounding analysis* is an analysis designed to overestimate or determine an upper limit to potential impacts or risks. A *bounding accident* is a hypothetical accident, the calculated consequences of which equal or exceed the consequences of all other potential accidents for a particular activity or facility.

Buffer zone: The unused or limited access area surrounding a testing site or an adjacent area to Kirtland Air Force Base (KAFB) boundary such as La Semilla Buffer Zone. The size and configuration of a buffer zone is designed to provide a protective space and is contingent upon different types and sizes of activities (e.g., quantities of explosives used, debris associated with a test, sound and vibration levels generated).

Candidate species: Plants and animals for which USFWS has sufficient information on biological status and threats to propose them as endangered or threatened under the Endangered Species Act of 1973 (ESA), for which development of a proposed listing regulation is precluded by other higher priority listing activities.

Carbon dioxide: A colorless, odorless, nonpoisonous gas that is a normal component of the ambient air and is a product of normal plant and animal respiration and of the decay of organic matter. It is a greenhouse gas that may affect the Earth's radiative balance and is the reference gas against which other greenhouse gases are measured. It is a potential industrial health hazard and asphyxiant at high concentrations.

Carbon monoxide: A colorless, odorless gas that is toxic if inhaled in high concentration over a period of time. It is formed as the product of the incomplete combustion of hydrocarbons (fuels).

Carcinogen: Any substance that causes cancer.

Centrifuge: A device that spins items in a circle at high velocities (speeds), which can be used to simulate high-gravity conditions.

Clean Air Act of 1970, (CAA): A U.S. federal law that mandates the promulgation and enforcement of air pollution control standards for stationary sources and motor vehicles.

Clean Air Act (CAA) Conformity: As the action's compliance with an implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS, expeditious attainment of such standards, and ensuring that such activities will not (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard, required interim emission reduction, or other milestones in any area.

Clean Water Act of 1972, (CWA): A U.S. federal law establishing the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality of surface waters.

Closure: Refers to the stabilization of a hazardous waste treatment, storage, or disposal unit (e.g., a waste treatment tank, waste storage building, landfill) when waste management activities are complete. For storage units, closure may include removal of residues, contaminated system components, and contaminated soil. For disposal units (i.e., where waste is left in place), closure typically includes site stabilization and placement of caps or other barriers.

Collaborating Entity: An entity with increased involvement in the SWEIS process to share information at earlier stages and provide enhanced outreach and collaboration.

Collective dose: The sum of individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. Collective dose is expressed in units of person-rem or person-sievert.

Community (biotic): All plants, animals, and living organisms occupying a specific area.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA): Also known as Superfund, administered by EPA to respond to releases or threatened releases of hazardous substances into the environment. CERCLA authorities complement those of the Resource Conservation and Recovery Act (RCRA), which primarily regulates ongoing hazardous waste handling and disposal. CERCLA's major emphasis is on the

cleanup of inactive hazardous waste sites and the liability for cleanup costs on arrangers and transporters of hazardous substances and on current and former owners of facilities where hazardous substances were disposed.

Contaminant: Any physical, chemical, biological, or radiological substance or matter in the environment at certain levels that may be harmful if exposed to or consumed. The presence of contaminants does not necessarily indicate a health risk.

Cooperating agency: Any federal, state, tribal, or local agency with jurisdiction by law or special expertise with respect to environmental impact involved in a proposal that has been designated by the lead agency.

Corrective Action: All corrective action necessary to protect human health and the environment for all releases of hazardous or mixed waste or hazardous constituents from any Solid Waste Management Unit or Area of Concern, regardless of the time at which waste was placed, as required under applicable state and federal regulations. Corrective Action may address releases to air, soil, sediment, surface water, or groundwater.

Criteria pollutant: An air pollutant regulated by NAAQS. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and PM (specifically, PM less than or equal to 10 micrometers [0.0004 inch] in diameter or less than or equal to 2.5 micrometers [0.0001 inch] in diameter).

Critical habitat: Habitat that has been designated as critical by USFWS or the National Marine Fisheries Service as essential to the conservation of an endangered or threatened species.

Criticality, nuclear reaction: The condition in which a system undergoes a sustained nuclear chain reaction.

Cultural resources: Prehistoric or historic sites, buildings, structures, districts, or other places or objects (including biota of importance) considered to be important to a culture, subculture, or community for scientific, traditional, or religious purposes or for any other reason. This includes archaeological sites, traditional use areas, and sacred or religious locations.

Curie: A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

Damage ratio: The fraction of material at risk when exposed to the effects of the energy, force, or stress generated by an event or accident that results in a release of radioactive material.

Decibel (dB): In acoustics, the decibel is a more practical subset of the Bell (B), which is the original unit of measurement of sound intensity; 1 dB being equal to 0.1 B. The decibel expresses the relative intensity of sounds on a logarithmic scale, meaning that each increase of 10 dB represents a tenfold increase in sound intensity. For example, a sound measured at 70 dB is 10 times more intense than one at 60 dB. For reference, a sound intensity of around 120 dB can cause pain to humans, and prolonged exposure to sounds above 85 dB can lead to hearing

loss. The A-weighted decibel (dBA) is the unit used to measure how loud a sound is as perceived by the human ear.

Decommission: The process of withdrawing a building, equipment, or a facility from active service.

Decontamination: The actions taken to reduce or remove contaminants that pose a substantial present or potential future hazard to human health or the environment.

Deflagration: A rapid chemical reaction in which the output of heat is sufficient to enable the reaction to proceed and be accelerated without input of heat from another source.

Depleted uranium: Uranium whose content of the fissile uranium-235 isotope is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium. Depleted uranium is a byproduct of the enrichment process used to produce fuel for nuclear reactors and weapons.

Design basis: Information that identifies the specific functions to be performed by a structure, system, or component and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design.

Design-basis accident: An accident or *maximum credible accident* involves accident conditions against which a facility is designed according to established design. In the context of a nuclear facility, it is a postulated accident for the purpose of establishing functional and performance requirements for safety structures, systems, and components.

Dose (chemical): The amount of a substance administered to, taken up by, or assimilated by an organism. It is often expressed in the amount of substance per unit mass of the organism, tissue, or organ of concern.

Dose (radiological): The amount of radiation energy absorbed by a material or biological tissue. Absorbed dose, dose equivalent, effective dose equivalent, and committed equivalent dose are all key terms associated with dose. The units of absorbed dose are the rad and the gray, and a rem is used as an approximation of the rad.

Dose equivalent: A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. It is defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and the sievert.

Dosimeter: A detection device for measuring the total accumulated exposure to ionizing radiation.

Dosimetry: The theory and application of the principles and techniques involved in measuring and recording radiation doses.

Drainage area: A geographic area within which stormwater, sediments, or dissolved substances drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

Ecology: A branch of science dealing with the interrelationships of living organisms with one another and their nonliving environment.

Ecosystem: A community of organisms and their physical environment interacting as an ecological unit.

Effective dose equivalent: The dose value obtained by multiplying the dose equivalents received by specified tissues or organs of the body by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all the resulting products. It includes the dose from radiation sources internal and external to the body. The effective dose equivalent is expressed in units of rem or sieverts.

Effluent: Treated or untreated air emissions or liquid discharges.

Eligible (cultural resource): A cultural resource that has been evaluated and reviewed by an agency and the State Historic Preservation Officer (SHPO) and determined eligible for inclusion in the National Register of Historic Places (NRHP).

Emission factor: A representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant.

Emission standards: Requirements established by local government, state, or EPA and limits the quantity, rate, or concentration of emissions of substances on a continuous basis.

Emissions: The discharge of physical or chemical substances/contaminants into the environment. Emissions can be released or discharged into various environmental media such as air, water, and/or soil. Emissions standards are established by local government, state, or EPA to protect human health and the environment.

Endangered species: Plants or animals that have been identified and listed consistent with the ESA, by USFWS or the National Marine Fisheries Service as in danger of extinction throughout all or a significant portion of their ranges.

Enriched uranium: Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) as which occurs in natural uranium.

Environmental assessment (EA): A concise public document, for which a federal agency is responsible, that serves to briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS) or a Finding of No Significant Impact.

Environmental impact statement (EIS): A detailed written statement that is required by Section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA), for a proposed major federal action significantly affecting the quality of the human environment.

Ephemeral: Lasting for a brief period of time, as in a temporary stream.

Erosion: The wearing away (i.e., weathering) of land surfaces by the action of wind or water.

Exotic (species): Species of plants and animals that are not native to a region. They often displace native species and may become pests.

Explosion (conventional): A chemical reaction or change of state that occurs in an exceedingly short time with the generation of high temperatures and large quantities of gaseous reaction products.

Explosion (nuclear): An explosion for which the energy is produced by a nuclear transformation, either fission or fusion. The term typically implies the release of enormous amounts (kilotons or megatons of trinitrotoluene [TNT] equivalent) of energy.

Exposure: The condition of being subject to the effects of, or acquiring a dose of, a potential stressor, such as a hazardous chemical agent or ionizing radiation. Also, the process by which an organism acquires a dose of a chemical stressor (e.g., mercury) or a physical agent (e.g., ionizing radiation). Exposure can be quantified as the amount of the agent available at various boundaries of the organism (e.g., skin, lungs, gut) and available for absorption. In the radiological context, *exposure* refers to the amount of ionizing radiation that a person or object is subjected to, typically measured in terms of the ionization produced in air.

Exposure pathway: The course a chemical or physical agent takes from the source to the exposed organism. An exposure pathway describes a mechanism by which chemicals or physical agents at or originating from a release site reach an individual or population. Each exposure pathway includes a source or release from a source, an exposure route, and an exposure point. If the exposure point differs from the source, a transport/exposure medium such as air or water is also included.

External exposures: Dose exposures that come from external sources and result in a whole-body dose.

Fault: A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred.

Finding of No Significant Impact: A public document that presents the reasons why a federal agency has concluded that there are no significant environmental impacts projected to occur upon implementation of the action described in an EA.

Firing: The discharge/release of energy by a particle accelerator, activation of a test rocket, and/or detonation of explosives including explosive propellant, in various contexts.

Fission: A nuclear transformation that is typically characterized by the splitting of a heavy nucleus into at least two other nuclei, the emission of one or more neutrons, and the release of a relatively large amount of energy. Fission of heavy nuclei can occur spontaneously or be induced by neutron bombardment.

Fissionable material: Includes any material capable of undergoing fission that encompasses both fissile materials (which can sustain a chain reaction) and other materials that can undergo fission but may not sustain a chain reaction under thermal neutron conditions.

Floodplain: A low-lying area of land next to a body of water that may flood during high water. Floodplains are subject to flooding with a one percent or greater chance of occurring in a given year.

Footprint:

Development Footprint: Represents the estimated square footage of a project/facility plus any construction laydown areas and temporary parking and access areas that may be required. To be conservative, this SWEIS assumes that the development footprint represents the maximum amount of land that could be disturbed.

Facility Footprint: The total square footage of all permanent facilities. The term *facility square footage* is used interchangeably.

Electrical Footprint: Refers to an energy usage area.

Fugitive dust: Organic or inorganic PM in quantities of and of a duration that may, with reasonable likelihood, injure human health, animal health, or plant life; reduce safe visibility; cause property damage; or degrade visibility.

Fugitive emissions: Uncontrolled emissions to the atmosphere from pumps, valves, flanges, seals, and other process points not vented through a stack. Fugitive emissions also include emissions from area sources such as ponds, lagoons, landfills, and piles of stored material.

Fusion: A nuclear reaction during which light nuclei are fused together to form a heavier nucleus, accompanied by the release of immense amounts of energy and fast neutrons.

Gamma rays, gamma radiation: High-energy, short-wavelength, electromagnetic radiation accompanying fission and emitted from the nucleus of an atom. Gamma rays are very penetrating. Gamma rays are similar to, but are usually more energetic than, x-rays.

Geology: The science of earth materials, processes, environments, and history of the planet, including rocks and their formation and structure.

Gram: The standard metric measure of weight, approximately equal to 0.035 ounces.

Gravity (g): As used in relation to earthquake ground motion, g is a measure of the maximum horizontal acceleration (as a percentage of the acceleration due to the Earth's gravity) experienced by a particle on the surface of the Earth.

Greenhouse gas: Gas that traps heat in the atmosphere. The primary greenhouse gases are carbon dioxide, methane, nitrous oxide, water vapor, and fluorinated gases such as sulfur hexafluoride.

Groundwater: Subsurface water supply in the saturated zone below the level of the water table.

Habitat: The place or area where populations of plants, animals, and other organisms normally live.

Half-life, radioactive: The time required for half the atoms of a particular radioisotope to decay into another isotope. A specific half-life is a characteristic property of each radioisotope. Measured half-lives range from millionths of a second to billions of years, depending on the stability of the nucleus.

Hazard analysis: The assessment of hazardous situations potentially associated with a process or activity. A hazard analysis includes the identification of material, system, process, and plant characteristics that can produce undesirable consequences. A safety analysis report hazard analysis examines the complete spectrum of potential accidents that could expose members of the public, onsite workers, facility workers, and the environment to hazardous materials.

Hazard Category (HC): HC is part of the Safety Basis process. The consequences of unmitigated releases of radioactive materials are evaluated as required by 10 CFR Part 830, and DOE-STD-1027-92, Change Notice No. 1 (DOE 1997b), defines and categorizes the radiological hazards of DOE/NNSA nuclear facilities. An HC-1 facility has a potential for significant offsite consequences; an HC-2 facility has a potential for significant onsite consequences beyond localized consequences; an HC-3 facility has a potential for only local significant consequences; and a Below HC-3 facility (also referred to as a “Less than HC-3 Facility”) has a potential for only consequences less than those that provide a basis for categorization as an HC-1, -2, or -3 nuclear facility.

Hazardous air pollutant (HAP): An air pollutant that is not covered by an NAAQS but that may present a threat of adverse human health effects or adverse environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, HAPs are any of the 188 air pollutants listed in or pursuant to CAA Section 112(b).

Hazardous chemical: Defined under 29 CFR 1910.1200(c) as “any chemical which is classified as a physical hazard or a health hazard, a simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise classified.” *Physical hazard* means a chemical that is classified as posing one of the following hazardous effects: explosive, flammable (gases, aerosols, liquids, or solids), oxidizer (liquid, solid, or gas), self-reactive, pyrophoric (liquid or solid), self-heating, organic peroxide, corrosive to metal, gas under pressure, or in contact with water emits flammable gas. *Health hazard* means a chemical that is classified as posing one of the following hazardous effects: acute toxicity (any route of exposure), skin corrosion or irritation, serious eye damage or eye irritation, respiratory or skin sensitization, germ cell mutagenicity, carcinogenicity, reproductive toxicity, specific target organ toxicity (single or repeated exposure), or aspiration hazard.

Hazardous constituent or hazardous waste constituent: (1) Any constituent identified in 40 CFR Part 261, Appendix VII, (2) any constituent identified in 40 CFR Part 261, Appendix VIII, or (3) any constituent listed in Table 1 of 40 CFR 261.24. For purposes of corrective action, *hazardous constituent* and *hazardous waste constituent* also mean any constituent identified in 40 CFR Part 264, Appendix IX.

Hazardous material: A material with the potential to cause illness, injury, or death to a person, or damage to a facility or to the environment, for these categories: Radioactive Material, Biological Agents, Explosives, or Hazardous Chemicals.

Hazardous waste: A category of waste regulated under RCRA, . To be considered hazardous, a waste must be a solid waste under RCRA, is not exempt from regulation, and must exhibit at least one of four characteristics described in 40 CFR 261.20 through 40 CFR 261.24 (ignitability, corrosivity, reactivity, or toxicity); or be specifically listed by EPA in 40 CFR 261.31 through 40 CFR 261.33.

High bay: A specially designed room with a high ceiling. These rooms are designed for industrial work that involves explosives, radioactive materials, and material processing.

High-efficiency particulate air (HEPA) filter: An air filter capable of removing at least 99.97 percent of particles 0.3 micrometer (about 0.00001 inch) in diameter. These filters include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.

Historic property (resource): A prehistoric or historic district site, building, structure, or object included in, or eligible for, inclusion on the NRHP, including artifacts, records, and material remains related to such a property or resource.

Hydrogeologic region: A tectonically and geologically defined area bounded by faults with distinctive but similar hydrogeologic characteristics such as groundwater circulation or porosity of the soil or rock material.

Hydrology: The science dealing with the properties, distribution, and circulation of natural water systems.

Industrial Facility Hazard Classification (IFHC): IFHC is part of the Safety Basis process. The consequences of unmitigated hazards are evaluated as required by Integrated Safety Management and the SNL/DOE Non-Nuclear Safety Basis Framework, which are implemented through Safety Basis chapters in the Environment, Safety, and Health Manual (SNL 2024a; SNL 2024b; SNL 2024c; and SNL 2024d). Industrial facilities are classified into the following levels based on potential impacts to receptors: (1) High (Offsite): the analysis of hazards shows the potential for significant offsite consequences from unmitigated hazards, (2) Moderate (Onsite): the analysis of hazards shows the potential for significant onsite consequences from unmitigated hazards, and (3) Low (Local): the analysis of hazards shows the potential for significant only localized, worker consequences from unmitigated hazards.

Inertial confinement fusion: Nuclear fusion, using the inertial properties of the reactants as a confinement mechanism.

Infectious waste: Any waste that is capable of transmitting an infectious agent to a living organism. This includes discarded materials such as live and weakened vaccines, blood, excretions or secretions, hypodermic needles, syringes, and broken glass items such as blood vials.

Infrastructure: The basic facilities, services, and installations needed for the functioning of a city, plant, or other facility such as electrical, gas, water, sewer, and communication.

Inorganic: Materials that generally do not contain carbon atoms and are not associated with living plants and animals. Metals are typical examples of inorganic substances.

Internal exposure: Radiation exposure from sources inside the body from materials ingested, inhaled, or absorbed through the skin.

Involved worker: Worker who would participate in a Proposed Action.

Ion: An atom or molecule with a positive or negative electrical charge.

Irradiation: The process of exposing a substance to ionizing radiation.

Isotope: Any of two or more variations of an element in which the nuclei have the same number of protons but a different number of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties but often different physical properties. (For example, carbon-12 and carbon-13 are stable, whereas carbon-14 is radioactive.)

Latent cancer fatality: Death resulting from cancer that becomes active after some time period following exposure to ionizing radiation or other carcinogens.

Lead: A bluish-white lustrous metal that is very soft, highly malleable, ductile, and a relatively poor conductor of electricity. Lead is very resistant to corrosion but tarnishes upon exposure to air.

Leak path factor (LPF): The fraction of airborne materials transported from containment or confinement deposition or from a filtration mechanism (e.g., fraction of airborne material in a glovebox leaving the glovebox under static conditions, fraction of material passing through a HEPA filter). LPF is one of the factors used to calculate the source term for an accident or event.

Liquefaction: The process that occurs when loosely packed, water-logged sediments at or near the ground surface lose their strength in response to strong ground shaking, such as from an earthquake.

Liter (L): The Système International d'Unités (SI) measure of capacity approximately equal to 1.057 quart.

Low-income population: Defined by the U.S. Census Bureau as a household income that is below the federal poverty level.

Low-level radioactive waste: Includes items that have become contaminated with radioactive material or have become radioactive through exposure to neutron radiation. It does not contain high-level waste, transuranic (TRU) waste, spent nuclear fuel, or byproduct tailings from the processing of radioactive materials.

Magnitude (of an earthquake): A quantity characteristic of the total energy released by an earthquake, as contrasted to *intensity*, which describes its effects at a particular place. Magnitude is determined by taking the common logarithm (base 10) of the largest ground motion recorded on a seismograph during the arrival of a seismic wave type and applying a standard correction factor for distance to the epicenter. Three common types of magnitude are Richter (or local) (M_L), P body wave (m_b), and surface wave (M_s). A one-unit increase in magnitude (e.g., from magnitude 6 to magnitude 7) represents approximately a 30-fold increase in the amount of energy released.

Major source: Any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit more than established annual thresholds for criteria air pollutants or HAPs.

Material at risk: The amount of radionuclides, in curies of activity or grams for each radionuclide, available for release when acted upon by a given physical insult, stress, or accident. The material at risk is specific to a given process in the facility of interest. It is not necessarily the total quantity of material present, but it is that amount of material in the scenario of interest postulated to be available for release.

Maximum contaminant level: The designation for EPA standards for drinking water quality under the Safe Drinking Water Act of 1974. The maximum contaminant level for a given substance is the maximum permissible concentration of that substance in drinking water delivered by a public water system.

Maximally exposed individual: A hypothetical member of the public who – because of realistically assumed proximity, activities, and living habits – would receive the highest radiation dose, taking into account all pathways, from a given event, process, or facility. This term should not be confused with the maximally exposed offsite individual used for accident analysis.

Maximally exposed offsite individual: A hypothetical person who receives the highest dose at or beyond the exclusion-area boundary for a 2-hour period during the passage of an airborne radioactive plume.

Mercury: A metallic element mostly obtained by reduction from cinnabar, one of its ores. Mercury is a heavy, opaque, glistening liquid (commonly called quicksilver) used in such instruments as barometers and thermometers.

Meteorology: The science dealing with the dynamics of the atmosphere and its phenomena, especially relating to weather.

Metric units: SI, also known as the International System of Units, commonly known as the metric system, is the international standard for measurement.

Microelectronics: Design, manufacture (or microfabrication), and use of very small electronic designs and components. Microelectronics components, including transistors, capacitors, inductors, resistors, diodes, and integrated circuits, are typically fabricated on semiconductor materials like silicon, using photolithography and other advanced manufacturing techniques, enabling the development of miniature electronic devices and systems.

Millirem: One-thousandth of a roentgen equivalent man (0.001 rem). Rem is a unit of measurement (i.e., dose equivalent) for the amount of ionizing radiation that causes a specific biological effect in humans.

Minority population: The U.S. Census Bureau defines a minority as any group other than non-Hispanic white, including American Indian or Alaskan Native; Asian or Pacific Islander; black, not of Hispanic origin; or Hispanic or Latino.

Mitigation: A way to reduce or prevent the negative effects of an action on human health and the environment. Mitigation can include the following: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the Affected Environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

Mixed waste: Waste that contains both (1) source material, SNM, or by-product material subject to the Atomic Energy Act, and (2) a hazardous component subject to state and federal hazardous waste regulations.

Nanoscale: Refers to the size range of approximately 1 to 100 nanometers. One nanometer is a billionth of a meter, or 0.000000001 meter or 0.0000000393701 inch.

National Ambient Air Quality Standards (NAAQS): Standards defining the highest allowable levels of certain pollutants in the ambient air. Because EPA must establish the criteria for setting these standards, the regulated pollutants are called criteria pollutants. Primary standards are established to protect public health; secondary standards are established to protect public welfare (e.g., visibility, crops, animals, buildings).

National Emission Standards for Hazardous Air Pollutants: Emissions standards set by EPA for air pollutants that are not covered by NAAQS and that may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR Parts 61 and 63.

National Environmental Policy Act of 1969 (NEPA): A federal law that requires federal agencies to consider the environmental impacts of their actions. NEPA establishes policy, sets goals (in Section 101), and provides means (in Section 102) for carrying out this Act. Section 102(2) contains “action-forcing” provisions to ensure that federal agencies follow the letter and spirit of NEPA. For major federal actions significantly affecting the quality of the human

environment, Section 102(2)(C) of NEPA requires federal agencies to prepare a detailed statement that includes the environmental impacts of the Proposed Action and other specified information.

National Historic Preservation Act of 1966 (NHPA): This Act establishes a national program to protect historic properties. The NHPA requires federal agencies to consider the impact of their actions on historic properties.

National Nuclear Security Administration (NNSA): A semi-autonomous agency within DOE) responsible for meeting the national security requirements established by the President and Congress to maintain and enhance the safety, reliability, and performance of the U.S. nuclear weapons stockpile.

National Pollutant Discharge Elimination System (NPDES): A provision of the CWA that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA; a state; or, where delegated, a tribal government. The NPDES permit lists either permissible discharge, the level of cleanup technology required for wastewater, or both.

National Register of Historic Places (NRHP): The official list of the Nation's historic places worthy of preservation. The National Park Service maintains the list under direction of the Secretary of the Interior. Buildings, structures, objects, sites, and districts are included in the NRHP for their importance in American history, architecture, archaeology, culture, or engineering. Properties included on the NRHP range from large-scale, monumentally proportioned buildings to smaller scale, regionally distinctive buildings. The listed properties are not just of nationwide importance; most are significant primarily at the state or local level. Procedures for listing properties on the NRHP are found in 36 CFR Part 60.

Natural phenomena hazard: A category of events (e.g., earthquake, severe wind, tornado, flood, lightning) that must be considered in DOE facility design, construction, and operations, as specified in DOE Order 420.1C Change 3 (LtdChg) (DOE 2019b).

Neutron: An uncharged elementary particle with a mass slightly greater than that of the proton, found in the nucleus of every atom heavier than hydrogen-1. Neutrons contribute to the stability of atomic nuclei by offsetting the repulsive forces between positively charged protons. They play a crucial role in nuclear reactions, including fission and fusion, and are involved in the formation of isotopes of elements. Free neutrons are unstable and decay into protons, electrons, and antineutrinos with a half-life of approximately 14 minutes. Interaction with atomic nuclei in matter results indirectly in ionization and thus an absorbed dose to biological material. Neutron bombardment of heavy nuclei (e.g., uranium, plutonium) can result in fission. Highly penetrating, neutrons can be stopped by thick masses of concrete, water, polyethylene, and/or paraffin.

Neutron generator: A device that initiates nuclear fission by providing a flux of neutrons at the proper time. A neutron generator consists of a neutron tube, miniature accelerator, power supply, and timer.

New Mexico special waste: Solid waste that has unique handling, transportation, or disposal requirements to assure protection of the environment and of public health, welfare, and safety. It

includes specific wastes such as ash and regulated asbestos waste, and also includes industrial solid waste that requires special handling or disposal to prevent harm to the environment, public health, or safety.

Nitrogen oxides: Refers to the oxides of nitrogen, primarily nitrogen oxide) and nitrogen dioxide. These are produced in the combustion of fossil fuels and are considered major air pollutants. When nitrogen dioxide combines with volatile organic compounds, in sunlight, ozone is produced.

Noise Control Act: Establishes a national policy to promote an environment for all Americans free from noise that jeopardizes health or welfare. The NCA's goal is to protect public health and reduce noise annoyance.

Nonattainment area: An area that EPA has designated as not meeting (i.e., not being in attainment of) one or more of the NAAQS for criteria pollutants. An area may be in attainment for some pollutants but not others.

Nonhazardous waste: Waste that does not meet the EPA definition of hazardous waste in 40 CFR Part 261 (including industrial solid waste and New Mexico special waste).

Nonproliferation: Preventing the spread of nuclear weapons, nuclear weapon materials, and nuclear weapon technology to rogue nations, terrorists, and countries that have not signed nonproliferation agreements.

Normal fault: A fault in which lengthening or extension of a portion of the Earth's crust causes a block of rock above the fault (hanging wall) to move downward relative to the block below (foot wall).

Notice of Availability (NOA): A formal notice, published in the *Federal Register*, that announces the issuance and public availability of a document or material for review or use. The EPA NOA is the official public notification of an EIS; an NNSA NOA is an optional notice used to provide information to the public.

Notice of Intent (NOI): A written document that informs of an intention to do something and can be used in many contexts. The NOI in the NEPA process serves as a formal announcement of intent to prepare an EIS. This marks the start of the public scoping period, which is an early and open process to determine the scope of issues for analysis, including identifying important issues and eliminating from further study unimportant issues.

Nuclear component: A part of a nuclear weapon that contains fissionable or fusionable material.

Nuclear facility: A facility that is subject to requirements intended to control potential nuclear hazards. A nuclear facility is defined in DOE directives as any nuclear reactor or any other facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees or the public.

Nuclear material: A composite term applied to (1) SNM; (2) source material such as uranium or thorium or ores containing uranium or thorium; and (3) byproduct material, which is any

radioactive material that is made radioactive by exposure to the radiation incident to the process of producing or using SNM.

Nuclear medicine: The science of medicine specializing in nuclear materials, including medical isotopes.

Nuclear particle acceleration: A method for imparting large kinetic energy to electrically charged subatomic nuclear particles by applying electrical potential differences for the purpose of physics experiments.

Nuclear weapon: Any weapon in which the explosion results from the energy released by reactions involving atomic nuclei (fission, fusion, or both).

Nuclear weapons complex: A network of sites/facilities that support the research, development, design, manufacture, testing, assessment, certification, and maintenance of the Nation's nuclear weapons and the subsequent dismantling of retired weapons.

Occupational Safety and Health Administration (OSHA): The federal agency that oversees and regulates workplace health and safety, created by the Occupational Safety and Health Act.

Optically stimulated luminescent (OSL) dosimeter: Passive radiation detection devices measuring the amount of ionizing radiation exposure. OSL dosimeters are used in radiation monitoring, personal dose monitoring, and luminescence dating.

Ordinance: Material including explosives, ammunition, and related equipment.

Ozone: The triatomic form of oxygen (oxygen-3). In the stratosphere, ozone protects the Earth from the Sun's ultraviolet rays; however, in lower levels of the atmosphere, ozone is considered an air pollutant. Ozone is a major constituent of smog.

Packaging, radioactive transportation: For radioactive materials, a container consisting of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shock. Packaging for radioactive materials must comply with U.S. Department of Transportation regulations in 49 CFR Parts 171 through 180 and U.S. Nuclear Regulatory Commission (NRC) regulations in 10 CFR Part 71.

Particle beam: A beam of atoms or subatomic particles that have been accelerated by a particle accelerating device.

Particulate matter (PM), PM₁₀, PM_{2.5}: Any finely divided solid or liquid material, other than uncombined (i.e., pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, PM₁₀ includes only those particles equal to or less than 10 micrometers (0.0004 inch) in diameter; PM_{2.5} includes only those particles equal to or less than 2.5 micrometers (0.0001 inch) in diameter. PM can result in increased respiratory symptoms, decreased lung function, aggravated asthma, development of chronic bronchitis, irregular heartbeat, nonfatal heart attacks, and premature death in people with heart or lung disease. PM_{2.5} is a major cause of reduced visibility.

Parts per million: A unit of measure for the concentration of a substance in its surrounding medium; for example, one million grams of water containing one gram of salt has a salt concentration of one part per million.

Peak ground acceleration: A measure of earthquake acceleration on the ground. The peak ground acceleration is the largest increase in velocity recorded by a particular station during an earthquake. It is used to set building codes and designate hazard risks.

Permissible exposure limit: Occupational exposure limit regulations endorsed by OSHA. May be for short term or 8-hour duration exposure.

Person-rem: A unit of collective radiation dose applied to populations or groups of individuals; that is, a unit for expressing the dose when summed across all persons in a specified population or group. One person-rem equals 0.01 person-sievert.

Plasma: A cloud of charged particles containing about an equal number of positive ions and electrons and exhibiting some properties of a gas but differing from a gas in being a good conductor of electricity and being affected by magnetic fields.

Plume: The elongated volume of contaminated water or air originating at a pollutant source such as an outlet pipe or a smokestack. A plume eventually diffuses into a larger volume of less contaminated material as it is transported away from the source.

Plutonium: A heavy, radioactive, metallic element with the atomic number 94. Plutonium is produced artificially by neutron bombardment of uranium. It has 15 isotopes with atomic masses ranging from 232 to 246 and half-lives from 20 minutes to 76 million years. Its most important isotope is fissile plutonium-239. Weapons-usable plutonium consists mainly of plutonium-239, which has a radiological half-life of 24,110 years.

Pollution prevention and waste minimization: Actions that economically avoid or reduce the generation of waste and pollution by means of source reduction, reduction in the toxicity of hazardous waste and pollution, improvement in energy use, and recycling. These actions are consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

Polychlorinated biphenyls (PCBs): A mixture of human-made organic chemicals known as chlorinated hydrocarbons that were manufactured for many products, including coolants, lubricants, paints, plastics, rubber, dyes, inks, adhesives, and pesticides. The manufacture of PCBs stopped in the United States in 1977 because of evidence that they build up in the environment and cause harmful effects. EPA has classified all PCBs as Group B2, possible human carcinogens.

Population dose (population exposure): Summation of individual radiation doses received by all those exposed to the source or event being considered. Population dose is the collective radiation dose received by a population group, usually measured in units of person-rem.

Post-Closure Care: Required for land disposal units that leave hazardous waste or hazardous waste constituents in place upon closure (i.e., landfills) or any other hazardous waste management unit that cannot achieve clean closure standards.

Prevention of significant deterioration (of air quality) (PSD): Regulations established to prevent significant deterioration of air quality in areas that already meet NAAQS. Specific details of PSD are found in 40 CFR 51.166.

Programmatic environmental impact statement (PEIS): A broad-scoped document that analyzes the potential environmental impacts of a policy, program, or plan, rather than a single project, allowing for a comprehensive assessment of potential effects across a wider range of actions within a specific area or category. PEISs may be prepared, and are sometimes required, for broad federal actions.

Proliferation: The spread of nuclear, biological, or chemical capabilities and the weapons (i.e., missiles) capable of delivering them to terrorists, rogue nations, and countries that have not signed nonproliferation agreements.

Propellant: Fuels and oxidizers physically or chemically combined that undergo combustion to provide propulsion.

Proposed species: Any species of fish, wildlife, or plant that is proposed in the *Federal Register* to be listed under ESA, Section 4.

Public: Anyone outside the boundary of SNL/NM-managed lands at the time of an accident or during normal operations.

Pulsed power: Electrical energy that is delivered in short, high-energy bursts.

Pulsed power technology: The science or study of accelerators and reactors technology associated with the design, fabrication, theory, and application that generate bursts of energy.

Pyrotechnics: The science and craft of manufacturing or setting off explosives.

Quality assurance: A system of activities whose purpose is to provide the assurance that standards of quality are attained with a stated level of confidence.

Radiation (ionizing): Alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions.

Radioactive decay: The process by which an unstable atomic nucleus loses energy in the form of ionizing radiation with the passage of time. A material containing unstable nuclei is considered radioactive. Three of the most common types of decay are alpha, beta, and gamma decay.

Radioactive waste: Waste that contains radioactive nuclides and is no longer useful regulated under the Atomic Energy Act. There are two broad classifications: high-level or low-level waste. At SNL/NM, most of the radioactive waste generated is low-level waste.

Radioactivity: A natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei and, thus, change (or decay) to atoms of a different element or to a lower energy state of the same element.

Radiography: An imaging technique using x-rays, gamma rays, or similar ionizing radiation and non-ionizing radiation to view the internal form of an object.

Radioisotope: A radioactive isotope is any of the species of the same chemical element that have different masses and unstable nuclei that emit radiation.

Radionuclide: A radioactive chemical element characterized according to its atomic mass and atomic number. Radionuclides can be made by people or naturally occurring and have potentially mutagenic (permanently change genetic material), teratogenic (cause damage to developing fetuses), or carcinogenic (cancer causing) effects on the human body.

Rare species: Populations and/or individuals occurring in very low numbers relative to other similar taxa in the state, although common or regularly occurring throughout much of their range. They may be found in a restricted geographic region or occur sparsely over a wider area. Although rare, populations are apparently stable.

Reasonably foreseeable (impacts): Impacts that are sufficiently likely to occur such that a reasonable person would take them into account when making a decision.

Recharge: The process by which water is added to a zone of saturation, usually by percolation from the soil surface.

Record of Decision (ROD): A concise public document that records a federal agency's decision(s) concerning a Proposed Action for which the agency has prepared an EIS. A ROD is prepared in accordance with the requirements of DOE regulations implementing procedures. A ROD identifies the alternatives considered in reaching the decision and factors balanced by the agency in making the decision.

Region of influence: The geographical area where potential impacts on a resource area could occur. The geographical extent of a region of influence varies for each resource area.

Regulated Unit: A surface impoundment, waste pile, land treatment unit, or landfill that received hazardous waste after July 26, 1982. At SNL/NM, the only regulated unit is the Chemical Waste Landfill.

Remediation: Corrective action necessary to protect human health and the environment for all releases of hazardous or mixed waste or hazardous constituents from a site. Remediation may address releases to air, soil, sediment, surface water, or groundwater.

Remote-handled waste: A type of TRU waste that has a high radiation dose rate and must be handled remotely to protect workers from unnecessary exposure.

Respirable fraction: The fraction of inhaled particles that are 10 micrometers or less that reach the unciliated airways of the lungs.

Rift: Long, narrow troughs that occur where tectonic plates in the Earth's crust move apart or away from each other along fault zones.

Riparian: Areas adjacent to rivers and streams that have a high density, diversity, and productivity of plant and animal species relative to nearby uplands.

Risk: The possibility of something bad happening. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of the event (i.e., the product of these two factors).

Risk assessment: The process of identifying, analyzing, and evaluating risks associated with a particular activity or project.

Risk factor: Numerical estimate of the severity of harm associated with exposure to a particular risk agent.

Robotics: The science or study of technology associated with the design, fabrication, theory, and application of robots.

Roentgen equivalent man (rem): A unit of measurement (i.e., dose equivalent) for the amount of ionizing radiation that causes a specific biological effect in humans. It is a combination of the amount of energy deposited in tissue and the medical effects of the radiation.

Runoff: Water that flows off the ground surface and into streams. It is a result of precipitation, such as rainfall or snow, that exceeds the amount of water that evaporates, transpires, or infiltrates into the ground.

Safe Drinking Water Act: Law that protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

Security: An integrated system of activities, systems, programs, facilities, and policies for the protection of controlled and other classified information or matter; nuclear materials; nuclear weapons and nuclear weapons components; and/or DOE or contractor facilities, property, and equipment.

Sedimentary fill: Subsurface loosely arranged rock made up of gravels, sands, silts, and clays.

Seismic: Pertaining to any earth vibration, especially related to an earthquake.

Seismicity: Refers to the geographic and historical distribution of earthquakes.

Semiconductor: Any of various solid crystalline substances having electrical conductivity between conductor and insulator. Devices made of semiconductors, notably silicon, are essential components of most electronic circuits.

Sensitive species: For this SWEIS, species within New Mexico that deserve special consideration in management and planning but are not listed as threatened or endangered. Also, a species designated by the U.S. Department of Agriculture Forest Service whose population

viability is a concern based on current or predicted numbers, density, distribution, or habitat capability.

Sievert: The SI unit of radiation dose equivalent. The dose equivalent in sieverts equals the absorbed dose in grays multiplied by the appropriate quality factor (1 sievert = 100 rem).

Silt: A sedimentary material consisting of fine mineral particles, intermediate in size between sand and clay.

Site-Wide Environmental Impact Statement (SWEIS): A type of PEIS that analyzes the environmental impacts of all, or selected, functions at a DOE site, including NNSA. As part of its NEPA implementing procedures, DOE prepares SWEISs for certain large, multiple-program DOE sites; it may prepare EISs or EAs for the other sites to assess the impacts of all or selected functions at those sites.

Sludge: Precipitated solid matter produced by water and waste treatment processes. Sludge falls under the definition of New Mexico Special Waste.

Socioeconomics: The science or study of social and economic factors.

Soil contamination: The presence of any toxic, hazardous, or radioactive substance in the unsaturated soil that exceeds naturally occurring levels and poses risk to human health or the environment.

Solid waste: Under RCRA, a solid waste is any garbage; refuse; sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; or other discarded material. Solid waste includes solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities. There are numerous regulatory exceptions to the definition of solid waste. For example, solid waste does not include solid or dissolved material in domestic sewage or irrigation return flows or industrial discharges that are point sources subject to permits under CWA Section 402. Finally, solid waste does not include source material, SNM, or byproduct material as defined by the Atomic Energy Act. A more detailed regulatory definition of solid waste can be found in 40 CFR 261.2.

Solid waste management unit: Any discernible unit at which solid waste has been placed at any time, and from which the regulatory agency determines there may be a risk of a release of hazardous waste or hazardous constituents, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area where solid wastes have been routinely and systematically released; they do not include one-time spills.

Sound level: The quantity in decibels measured by a sound-level meter satisfying requirements of the specifications for sound level meters in American National Standard Institute S1.4-2014. Sound level is the frequency-weighted sound pressure level obtained with the standardized dynamic characteristic “fast” or “slow” and weighting A or C.

Sound pressure level: The level of the A-weighted sound pressure referenced to 20 level micropascals (for air).

Special nuclear material (SNM): (1) Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the commission, pursuant to the provisions of section 2071 (of the Atomic Energy Act, determines to be SNM, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material.

Species of concern: Species about which there are some concerns regarding status and threats, but insufficient information is available to list the species.

Sponsor: An entity (i.e., federal agencies; state and local governments; universities; and U.S. and foreign industries) outside of DOE or NNSA that provides resources and support for the work that is performed by SNL/NM.

Stability class: A category characterizing the degree of stability, or absence of turbulence, in the atmosphere. Stability class is the classification used for regulatory models and methods for estimating the appropriate stability category from other meteorological data. The least stable category is class A, in which the high level of turbulence causes air pollutants from any particular source to mix rapidly with surrounding air, thereby reducing pollutant concentrations. The most stable category is class F, in which pollutants are not well mixed but remain in relatively high concentrations within a smaller volume. Sometimes a seventh category (i.e., G, or extremely stable) is used to represent extremely stagnant conditions.

State Historic Preservation Officer (SHPO): A government official who manages a state's historic preservation program. The SHPO is a participant in the NHPA Section 106 process, assisting in identifying and protecting historic properties and reviewing nominations for properties to be included in the NRHP.

Stewardship (environmental restoration): Activities necessary to maintain long-term protection of human health and the environment from residual contamination.

Stockpile stewardship: Activities associated with research, design, development, and testing of nuclear weapons and the assessment and certification of their safety and reliability.

Stormwater pollution prevention plan: A plan required by an NPDES permit for controlling stormwater pollution resulting from construction or industrial activities.

Sulfur dioxide: A heavy, pungent, colorless gas formed in the combustion of fossil fuels and considered a major air pollutant. During its long-range transport, sulfur dioxide can combine with water vapor to form sulfuric acid, which contributes to the formation of acid rain; damages trees, crops, and buildings; and makes soils, lakes, and streams acidic. It also contributes to reduced visibility and can irritate the upper respiratory tract and cause lung cancer.

Sulfur hexafluoride: An inorganic, colorless, odorless, nonflammable, extremely potent greenhouse gas, which is an excellent electrical insulator.

Superfund Amendments and Reauthorization Act (SARA): Enacted in 1986, and reauthorized CERCLA for 5 years at a total funding level of \$8.5 billion. SARA more stringently defines remedial actions and emphasizes remedies that permanently and significantly reduce the

mobility, toxicity, or volume of hazardous substances. Title III of SARA, the Emergency Planning and Community Right-to-Know Act, mandates establishment of community emergency planning programs, emergency notification, reporting of chemicals, and emission inventories.

Surface water: Water that collects on the surface of the ground.

Système International d’Unités (SI): An international system of physical units that include meter (length), gram (mass), kelvin (temperature), becquerel (radioactivity), gray (radioactive dose), and sievert (dose equivalent). Also known as the International System of Units.

Target: An item to be impacted (e.g., in a rocket sled test), tested, or irradiated; or a goal for reducing emissions or consumptions such as water or energy.

Temporary Emergency Exposure Limit: Limit developed by the DOE Subcommittee on Consequences Assessment and Protective Actions for chemicals for which Emergency Response Planning Guideline values are not available and serve as temporary guidance until such values can be developed.

Threatened species: Any plants or animals that are likely to become an endangered species within the foreseeable future throughout all or a significant portion of their ranges and that have been listed as threatened by USFWS or the National Marine Fisheries Service.

Throughput: The number of items undergoing a process, or the amount of material consumed by a process.

Topography: The general configuration of a land surface, including its relief and the position of its natural and engineered features.

Total effective dose equivalent: The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Toxic Substances Control Act of 1976 (TSCA): Act authorizing EPA to secure information on all new and existing chemical substances and to control any of these substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by EPA before they are manufactured for commercial purposes.

Toxic Substances Control Act (TSCA)-regulated waste: Waste regulated by TSCA, which addresses the production, importation, use, and disposal of specific chemicals, including PCBs, asbestos, radon, and lead-based paint. TSCA waste is waste generated from TSCA materials exceeding identified limits in the Act and supporting regulations. The bulk of TSCA wastes generated at SNL/NM come from decontamination and decommissioning activities.

Traditional Cultural Place (TCP): A physical property that is associated with a community's cultural practices, beliefs, history, and identity. TCPs are eligible for inclusion in the NRHP.

Transport pathways: Man-made or natural routes through which substances or contaminants move from their source to various receptors in the environment, including soil, water, air, and living organisms.

Transuranic (TRU): An artificially made, radioactive element that has an atomic number higher than uranium (i.e., atomic number 92) in the periodic table of elements such as neptunium, plutonium, americium, curium, and others.

Transuranic (TRU) waste: Radioactive waste that is not classified as high-level radioactive waste and that contains more than 100 nanocuries (3,700 becquerels) per gram of alpha-emitting TRU isotopes with half-lives greater than 20 years, except for waste that DOE has determined, with the concurrence of EPA, does not need the degree of isolation called for by 40 CFR Part 191; or waste that NRC has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Tritium: A radioactive isotope of hydrogen (hydrogen-3) whose nucleus contains one proton and two neutrons.

U.S. Department of Energy (DOE): The federal agency responsible for ensuring the Nation's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.

U.S. Environmental Protection Agency (EPA): The federal agency responsible for protecting human health and the environment. Although some of this responsibility may be delegated to state and local regulatory agencies, EPA retains oversight authority to ensure protection of human health and the environment.

U.S. Nuclear Regulatory Commission (NRC): The federal agency charged to ensure the safe use of radioactive materials for beneficial civilian purposes while protecting people and the environment. The NRC regulates commercial nuclear power plants and other uses of nuclear materials, such as in nuclear medicine, through licensing, inspection, and enforcement of its requirements.

Uranium: A radioactive, metallic element with the atomic number 92; the heaviest naturally occurring element. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission, and uranium-238 is transformed into fissionable plutonium-239 following its capture of a neutron in a nuclear reactor.

Vadose zone: The region of soil and rock between the ground surface and the top of the water table in which pore spaces are only partially filled with water.

Viewshed: The extent of the area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

Visual Resource Management: A process devised by the Bureau of Land Management to assess the aesthetic quality of a landscape and, consistent with the results of that analysis, to design proposed activities so as to minimize their visual impact on that landscape. The process

consists of a rating of visual quality followed by a measurement of the degree of contrast between proposed development activities and the existing landscape. Four classifications are employed to describe different degrees of modification to landscape elements: Class I, areas where the natural landscape is preserved, including national wilderness areas and the wild sections of national wild and scenic rivers; Class II, areas with very limited land development activity, resulting in visual contrasts that are seen but do not attract attention; Class III, areas in which development may attract attention, but the natural landscape still dominates; and Class IV, areas in which development activities may dominate the view and may be the major focus in the landscape.

Volatile organic compound: A broad range of organic chemical compounds that evaporate under normal room temperature and pressure, such as benzene, chloroform, and methyl alcohol, as well as other solvents.

Waste characterization: The identification of all waste composition and properties by reviewing process knowledge, nondestructive examination, nondestructive assay, or sampling and analysis. Characterization provides the basis for determining appropriate storage, treatment, handling, transportation, and disposal requirements.

Waste Isolation Pilot Plant (WIPP): A DOE facility designed and authorized to permanently dispose of defense-generated TRU radioactive waste in a deep underground geologic repository facility. The WIPP is in southeastern New Mexico, 26 miles (42 kilometers) east of the City of Carlsbad.

Wastewater: Water originating from human sanitary water use (i.e., domestic wastewater) and from a variety of industrial processes (i.e., industrial wastewater).

Water intensity: The ratio of all water used in a building to the building's gross square footage; gross square footage is the sum of all areas on all floors of a building that are included within the outside faces of its exterior walls.

Watershed (drainage basin): An extent or an area of land where surface water from rain and melting snow or ice converges to a single point, usually the exit of the basin, where the waters join another water body, such as an arroyo, river, lake, reservoir, estuary, wetland, sea, or ocean. The watershed includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels. It is separated from adjacent basins by a drainage divide. The watershed acts as a funnel by collecting all the water within the area covered by the basin and channeling it to a single point. Each watershed is separated topographically from adjacent watersheds by a geographical barrier such as a ridge, hill, or mountain.

Water quality standard: Limit on the concentrations of specific constituents or on the characteristics of water, often based on water use classifications (e.g., drinking water, recreation, propagation of fish and aquatic life, agricultural and industrial use). Water quality standards are legally enforceable under the CWA, whereas water quality criteria are non-enforceable recommendations based on biotic impacts.

Water table: The boundary between the two zones below ground surface: the upper unsaturated zone (also called the vadose zone) and the deeper saturated zone that is filled with water.

Weapons of mass destruction: Umbrella term that includes nuclear, radiological, chemical, biological, or other devices that are intended to harm many people.

Wetland: An area that is inundated by surface water or groundwater with a frequency sufficient to support and, under normal circumstances, does or would support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas (e.g., sloughs, potholes, wet meadows, river overflow areas, mudflats, natural ponds). *Jurisdictional wetlands* are those wetlands protected by the CWA. They must have a minimum of one positive wetland indicator from each parameter (i.e., vegetation, soil, and hydrology). The U.S. Army Corps of Engineers requires a permit to fill or dredge jurisdictional wetlands.

Wildlife corridor: Passageways used by animals to move between various parts of their home range or, during migration, to move from summer (breeding) to winter ranges.

Withdrawn Area: Consists of land withdrawn from public use from the Cibola National Forest for the Department of the Air Force and DOE purposes established under Public Land Orders. DOE withdrawn land that is SNL/NM-managed lands is in the eastern portion of KAFB.

X-ray: Penetrating electromagnetic radiation having a wavelength much shorter than that of visible light, as well as ultraviolet light. X-rays originate outside the nucleus, either when the inner orbital electrons of an excited atom return to their normal state or when a metal target is bombarded with high-speed electrons.

APPENDIX K
SECTION 102 REGULATORY COMMENTS

CONTENTS

K.1	Comments of Appropriate Federal, State, and Local Agencies Authorized to Develop and Enforce Environmental Standards	K-1

Appendix K – Section 102 Regulatory Comments

K.1 COMMENTS OF APPROPRIATE FEDERAL, STATE, AND LOCAL AGENCIES AUTHORIZED TO DEVELOP AND ENFORCE ENVIRONMENTAL STANDARDS

As specified in Section 102(C) of the National Environmental Protection Act of 1969 (42 U.S.C. § 4332(C)), Sandia National Laboratories consulted with appropriate federal, state, and local agencies authorized to develop and enforce environmental standards. Only one comment was collectively received from regulatory agencies. This comment was from the Environmental Protection Agency (EPA), Region 6, dated February 4, 2026; a copy of which is included within this appendix.

The response to this comment was to amend Appendix H to clarify that use limitations for endangered species protections were included as applicable regulations for pesticide and herbicide application.

**REGION 6**

DALLAS, TX 75270

February 4, 2026

Dr. Adria Bodour
National Nuclear Security Administration
Sandia Field Office, P.O. Box 5400
Albuquerque, New Mexico 87185
nepa@nnsa.doe.gov

Re: EPA Draft EIS Comments for the Continued Operation of Sandia National Laboratories,
Albuquerque, New Mexico

Dear Dr. Bodour:

The United States Environmental Protection Agency has reviewed the National Nuclear Security Administration Site Wide Environmental Impact Statement for the above referenced project. EPA's comments are provided pursuant to the National Environmental Policy Act and our NEPA review authority under Section 309 of the Clean Air Act.

The Site Wide EIS details how operations will be conducted at SNL under different alternatives, including construction and operation of new facilities, modernization/upgrade of existing facilities and utilities, modification of operations, and/or demolition of excess and aging facilities. The EIS focuses solely on SNL operations and analyzes potential environmental impacts of reasonable alternatives for continued SNL operations through the next 15 years (2025 – 2040).

EPA appreciates the opportunity to provide comments and looks forward to continued participation in the NEPA process. Please submit the Final EIS electronically EPA's Federal Activities Division using the following link: <https://www.epa.gov/nepa/environmental-impact-statement-filing-guidance>. If you have any questions, please contact me at (214) 665-8565, or contact Gabe Gruta, project review lead at (214) 665-2174 or gruta.gabriel@epa.gov.

Sincerely,

**ROBERT
HOUSTON**

Digitally signed by
ROBERT HOUSTON
Date: 2026.02.04
08:19:03 -0600

Robert Houston
Acting Branch Manager
Environmental Review Branch

Enclosure: EPA's Detailed Draft EIS Comments

**EPA's Detailed Draft EIS Comments
for the proposed
Continued Operation of Sandia National Laboratories,
Albuquerque, New Mexico**

Pesticides

Appendix H of the Draft EIS addresses the application of herbicides and pesticides in accordance with label instructions and applicable regulatory requirements. EPA recommends that all pesticides applied be with EPA under the Federal Insecticide, Fungicide, and Rodenticide Act. Restricted Use Pesticides must be applied by a certified applicator in the appropriate category. Additional requirements may apply under New Mexico's applicator certification and training program. Applicators should consult EPA's *Bulletins Live! Two* system to ensure compliance with the Endangered Species Act. The link is located here: <https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins>