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Draft
Environmental Assessment of Proposed Changes for Analytical Chemistry and Materials Characterization at the Radiological Laboratory/Utility/Office Building, Los Alamos National Laboratory, Los Alamos, New Mexico

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ACRONYMS AND ABBREVIATIONS

AC	analytical chemistry
ALARA	as low as reasonably achievable
ARF	airborne release fraction
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CH-TRU	contact-handled transuranic
CMR	Chemistry and Metallurgy Research
CMRR	Chemistry and Metallurgy Research Building Replacement
CMRR-NF	Chemistry and Metallurgy Research Building Replacement Nuclear Facility
DD&D	decontamination, decommissioning, and demolition
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DR	damage ratio
DSA	documented safety analysis
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FGR	Federal Guidance Report
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FTE	full-time equivalent
FY	fiscal year
GTCC	greater-than-Class C
HEPA	high-efficiency particulate air
HVAC	heating, ventilation, and air-conditioning
ICRP	International Commission on Radiation Protection
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LCF	latent cancer fatality
LEED	Leadership in Energy and Environmental Design
LPF	leak path factor
LLW	low-level radioactive waste
MAR	material at risk
MC	materials characterization
MDA	material disposal areas
MEI	maximally exposed individual
MLLW	mixed low-level radioactive waste
MOX	mixed oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
OSHA	Occupational Safety and Health Administration

PAC	protective action criteria
PC	Performance Category
PF-4	Plutonium Facility, Building 4
PIDADS	perimeter intrusion, detection, assessment, and delay system
PuE	plutonium-239 equivalent
RANT	Radioassay and Nondestructive Testing Facility
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RF	respirable fraction
RLUOB	Radiological Laboratory/Utility/Office Building
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROI	region of influence
SA	supplement analysis
SDC	seismic design category
SNL	Sandia National Laboratories
SNM	special nuclear material
SRS	Savannah River Site
SSC	structures, systems, and components
TA	Technical Area
TFF	Target Fabrication Facility
TQ	threshold quantity
TRU	transuranic
TRUPACT	Transuranic Package Transporter
USFWS	U.S. Fish and Wildlife Service
WCS	Waste Control Specialists
WIPP	Waste Isolation Pilot Plant

SUMMARY

The U.S. Department of Energy (DOE) has prepared this environmental assessment (EA) in compliance with: (1) Council on Environmental Quality (CEQ) regulations (Title 40 of the *Code of Federal Regulations*, Parts 1500 through 1508 [40 CFR Parts 1500–1508]); (2) DOE's National Environmental Policy Act (NEPA) implementing procedures at 10 CFR Part 1021; and (3) other applicable Federal statutes. In accordance with 40 CFR 1508.9(a) and 10 CFR 1021.321(b), this EA is intended to provide sufficient evidence and analysis to determine whether to prepare an environmental impact statement (EIS) or to issue a Finding of No Significant Impact (FONSI) for the Proposed Action.

The National Nuclear Security Administration (NNSA) has a need for enduring analytical chemistry (AC) and materials characterization (MC) capabilities at Los Alamos National Laboratory (LANL). The Chemistry and Metallurgy Research (CMR) Building in LANL's Technical Area (TA)-3, where AC and MC operations have historically occurred, cannot be operated to the full extent needed for these operations (DOE 2003b). In 2015, NNSA issued the *Supplement Analysis, Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (*2015 CMRR SA*) (DOE/EIS-0350-SA-2) (DOE 2015a), which evaluated the environmental impacts of performing AC and MC operations at two existing LANL facilities in TA-55. One facility is the existing Hazard Category 2 Plutonium Facility, Building 4 (PF-4), and the second is the Radiological Laboratory/Utility/Office Building (RLUOB). RLUOB, for which construction was completed in 2011, contains laboratory and office space, training and operations centers, and an incident command center. Because changes to the programs performed in PF-4 enabled repurposing of laboratory space at PF-4 to support AC and MC operations, and changes in radiation dosimetry and accident release fractions increased the quantity of plutonium-239 equivalent (PuE)[1] permitted in a Radiological Facility such as RLUOB to 38.6 grams, it became possible to provide AC and MC capabilities using a combination of laboratory space already available in RLUOB and space to be made available in PF-4.

DOE prepared this EA because NNSA has now identified the potential to recategorize RLUOB from a Radiological Facility to a Hazard Category 3 Nuclear Facility, with an increased material-at-risk (MAR) limit of 400 grams PuE (15 percent of the 2,610 grams of PuE allowed in a Hazard Category 3 Nuclear Facility), which would allow certain laboratory capabilities previously planned for PF-4 to be installed in RLUOB. As a result, fewer modifications to PF-4 would be required, while additional modifications would be made to RLUOB. Modifications to PF-4 and RLUOB would not require changes to the structure of either facility. NNSA therefore prepared this EA to evaluate: (1) a Proposed Action Alternative reflecting recategorization of RLUOB to a MAR-limited Hazard Category 3 Nuclear Facility, with more AC and MC operations at RLUOB than those evaluated in the *2015 CMRR SA*, and (2) a No Action Alternative that maintains RLUOB as a Radiological Facility, as evaluated in the *2015 CMRR SA*. Eight to ten years would be required for facility modifications under the Proposed Action Alternative, while seven to nine years would be required under the No Action Alternative.

To evaluate the potential environmental consequences from implementing these alternatives, a screening analysis was performed on all resource areas. For the following resource areas, environmental impacts were determined to be minimal and were not evaluated in detail: land use, geology and soils, water

[1] Because the threshold quantity (TQ) for plutonium-239 in a Hazard Category 3 Nuclear Facility was changed from 8.4 grams to 38.6 grams, up to 38.6 grams of plutonium-239 can be handled within a Radiological Facility. This change in the TQ is a function of an enhanced understanding of dosimetry and revised accident release fractions. That is, the health risk associated with 8.4 grams of plutonium-239, as calculated using the previous dosimetry and accident release fractions, yields the same health risk as 38.6 grams of plutonium-239, as calculated using the updated dosimetry and accident release fractions.

resources, biological resources, cultural resources, air quality and climate, visual resources and noise, infrastructure, and socioeconomics. The resource areas of public interest (i.e., human health, facility accidents, waste management, transportation, and environmental justice) were evaluated in more detail in this EA. Information from the analyses is summarized below:

- Under both alternatives, no radiation doses or risks are expected among members of the public due to modifications at PF-4 and RLUOB. The radiation doses received by members of the public during operations would be compliant with regulatory requirements and slightly smaller under the Proposed Action Alternative than those under the No Action Alternative. Under both alternatives, no latent cancer fatalities (LCFs) are expected among the population within 50 miles of RLUOB or PF-4. The annual risk of a maximally exposed individual (MEI) sustaining an LCF is about 5×10^{-8} (1 chance in 20 million of an LCF) under the Proposed Action Alternative and 1×10^{-7} (1 chance in 10 million of an LCF) under the No Action Alternative. The annual risk of an average individual in the population within 50 miles of RLUOB or PF-4 is about 1×10^{-9} (1 chance in 1 billion of an LCF). All radiation doses to members of the public would be far smaller than the radiation doses received from natural background radiation.

- Under both alternatives, involved workers would receive radiation exposures during facility modifications, arising primarily from activities at PF-4. The annual average individual dose received by these workers (300 millirem) would be approximately the same under both alternatives. The total dose received by involved workers for PF-4 modifications would be about 200 person-rem under the Proposed Action Alternative or 253 person-rem under the No Action Alternative. No LCFs are expected among the involved worker population under either alternative (calculated values are 0.2 LCF or less).

- Under both alternatives, an average involved worker at PF-4 would receive an annual dose of about 170 millirem during operations, while an average involved worker at RLUOB would receive an annual dose of about 10 millirem. At both facilities, the annual dose that would be received by an average involved worker is much less than DOE's dose limit in 10 CFR Part 835 for radiation workers of 5,000 millirem in a year and less than the administrative dose limit for LANL activities of 500 millirem in a year. The collective annual radiation dose received by involved workers during operations would be smaller under the Proposed Action Alternative than that under the No Action Alternative (9.5 versus 11 person-rem). No annual LCFs are expected among the involved workers under either alternative (calculated values are 7×10^{-3} or less).

- Neither alternative would materially change risks from potential accidents at PF-4 because the PF-4 MAR and the types of accidents that could occur would not change for either alternative. Accident risks at RLUOB could increase under the Proposed Action Alternative relative to the No Action Alternative, but the risks under both alternatives would be small. None of the

Radiation Dose and Risk Terms

Roentgen equivalent man (rem) – A unit of radiation dose used to measure the biological effects of different types of radiation on humans. The dose in rem was estimated using a formula that accounts for the type of radiation, the total absorbed dose, and the tissues involved. One thousandth of a rem is a millirem.

Person-rem – A unit of collective radiation dose applied to a population or group of individuals. It is calculated as the sum of the estimated doses, in rem, received by each individual of the specified population. For example, if 1,000 people each received a dose of 1 millirem, the collective dose would be 1 person-rem (1,000 persons × 0.001 rem).

Latent cancer fatalities (LCFs) – Deaths from cancer resulting from, and occurring sometime after, exposure to ionizing radiation or other carcinogens. This environmental assessment focuses on LCFs as the primary means of evaluating health risk from radiation exposure. The values reported for LCFs are the increased risk of a fatal cancer for an individual worker or member of the public, or the increased risk of a single fatal cancer occurring in an identified population comprising workers or members of the public (e.g., the public within a 50-mile radius of a nuclear facility).

accidents evaluated for either alternative would result in an LCF in the population within 50 miles of RLUOB; similarly, none of the accidents evaluated for either alternative is expected to result in an LCF to an MEI or onsite noninvolved worker (that is, the risk of an LCF is much less than 1). The potential accident with the largest risks is a seismic-induced spill and fire under the Proposed Action Alternative. For this accident, no LCFs are expected in the population within 50 miles of RLUOB (calculated value: 2×10^{-5} LCF). The risk of an LCF to the MEI is about 2×10^{-8} (1 chance in about 50 million of an LCF), while the risk of an LCF to the onsite noninvolved worker is about 4×10^{-8} (1 chance in 25 million of an LCF).

- Under both alternatives, accident risks due to ongoing AC and MC operations in the CMR Building and transfer of material between the CMR Building in TA-3 and facilities in TA-55 would be eliminated because operations in the CMR Building would cease, and materials would not be shipped between the CMR Building and TA-55. Overall, NNSA expects that moving AC and MC operations from the CMR Building to RLUOB and PF-4 in TA-55 would lower accident risks.

- Under both alternatives, modifications to RLUOB and PF-4 would generate transuranic (TRU) waste,[2] low-level radioactive waste (LLW), and mixed low-level radioactive waste (MLLW) in comparable quantities. Under the Proposed Action Alternative, a total of 3,030 cubic feet of TRU waste, 4,760 cubic feet of LLW, and 3,460 cubic feet of MLLW would be generated during modifications at PF-4 and RLUOB. Under the No Action Alternative, TRU waste, LLW, and MLLW generation during modifications at PF-4 and RLUOB would be larger than that for the Proposed Action Alternative by about 16 percent, 29 percent, and 57 percent, respectively. Under both alternatives, AC and MC operations would (conservatively) annually generate about 2,370 cubic feet of TRU waste, 71,280 cubic feet of LLW, and 700 cubic feet of MLLW. Facility modifications and AC and MC operations would also generate small quantities of hazardous (or other chemical) waste, nonhazardous waste, and sanitary waste.

- Under both alternatives, TRU waste from facility modifications and operations would be safely stored pending shipment to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. Under the Proposed Action and No Action Alternatives, the TRU waste quantities would represent about 0.4 percent and 0.5 percent, respectively, of the WIPP unsubscribed disposal capacity for contact-handled TRU waste. Under both alternatives, LLW, MLLW, and chemical waste generated from facility modifications and AC and MC operations would be shipped to offsite treatment or disposal facilities. Nonhazardous waste would be shipped to offsite facilities for recycle or disposal. Ample offsite treatment or disposal capacity exists for all wastes.

- Under both alternatives, transport of radioactive waste from facility modifications to offsite facilities would not result in an LCF among the transport crew or populations along the transport route. Assuming an individual member of the public was exposed under incident-free transport conditions to radiation emitted from all radioactive waste shipments, that individual would sustain under both alternatives a maximum risk of about 3×10^{-9}, or 1 chance in about 330 million of an LCF. Assuming a maximum reasonably foreseeable accident occurred (one with an annual probability of a severe accident larger than 1 in 10 million), no LCFs are expected among the population affected by the accident, and the risk to the MEI would be about 5×10^{-6}, or 1 chance in 200,000 of an LCF.

- Under both alternatives, transport of radioactive waste from AC and MC operations to offsite facilities would not result in an annual LCF among the transport crew or populations along the

[2] The analysis of TRU waste management in this section includes mixed TRU waste. All TRU waste generated under the EA alternatives would be contact-handled TRU waste.

transport route. Assuming an individual member of the public was exposed under incident-free transport conditions to radiation from all radioactive waste shipments, that individual would sustain an annual risk of about 8×10^{-9}, or 1 chance in about 125 million of an LCF. The maximum reasonably foreseeable accident would be the same as analyzed for transport of radioactive waste from facility modifications.

- Under both alternatives, radioactive emissions to the air from AC and MC operations would result in no disproportionately high and adverse effects on minorities or low-income populations within 50 miles of RLUOB or PF-4. Annual radiation doses to an individual hypothetically located at the nearest boundary of the Pueblo de San Ildefonso or Santa Clara Pueblo would be smaller than the doses calculated for the MEI, who would be located much closer to RLUOB or PF-4 than the pueblo boundaries. Thus, there would be no disproportionately high and adverse effects on the hypothetical maximally exposed Native American individuals.
- The actions evaluated in this EA would produce little or no impacts and would generally produce fewer impacts than AC and MC operations in the old CMR Building. Therefore, the actions evaluated in this EA would not substantially contribute to cumulative impacts.

DOE is soliciting comments on the Draft EA during a 30-day public comment period. The Draft EA is available on the DOE NEPA website (https://energy.gov/node/2501991). Copies of the Draft EA were made available to the State of New Mexico and the four accord Native American Tribal Governments and were placed in the local DOE reading room. All comments on the Draft EA provided within the 30-day comment period will be considered by NNSA in preparing the Final EA. The Final EA will include a summary of the comments received on the Draft EA, as well as NNSA's response to the comments.

1.0 INTRODUCTION

The U.S. Department of Energy (DOE), National Nuclear Security Administration (NNSA), has prepared this *Draft Environmental Assessment of Proposed Changes for Analytical Chemistry and Materials Characterization at the Radiological Laboratory/Utility/Office Building, Los Alamos National Laboratory, Los Alamos, New Mexico*. This environmental assessment (EA) evaluates the potential environmental impacts of recategorizing the Radiological Laboratory/Utility/Office Building (RLUOB) at Los Alamos National Laboratory (LANL) to a material-at-risk (MAR)-limited,[3] Hazard Category 3 Nuclear Facility. RLUOB is currently approved to operate as a Radiological Facility, i.e., a facility that does not meet the threshold criteria of a Hazard Category 3 Nuclear Facility, but still possesses radioactive material. Under the Proposed Action, DOE/NNSA would add capabilities at RLUOB and conduct a broader range of analytical chemistry (AC) and materials characterization (MC) analyses in the facility (see text box). The Proposed Action would maximize use of RLUOB laboratory space for AC and MC operations and reduce the amount of space required in the existing Hazard Category 2 Plutonium Facility, Building 4 (PF-4), for these operations, compared to the scenarios analyzed in the 2015 *Supplement Analysis, Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (*2015 CMRR SA*) (DOE/EIS-0350-SA-2) (DOE 2015a).

Analytical Chemistry and Materials Characterization

AC involves the study, evaluation, and analysis of materials. In general terms, AC is a branch of chemistry that addresses the separation, identification, and determination of the components in a sample. Examples of sample analysis activities include assay and determination of isotopic ratios of plutonium, uranium, and other radioactive materials, as well as identification of major and trace elements in materials; the content of gases; constituents at the surfaces of various materials; and methods to characterize waste constituents in hazardous and radioactive materials. MC relates to the measurement of basic material properties and the changes in those properties as a function of temperature, pressure, or other factors. AC and MC operations support actinide research and development capabilities and NNSA strategic objectives for stockpile stewardship and management at LANL and other sites across the DOE Complex.

DOE has prepared this EA in compliance with: (1) Council on Environmental Quality (CEQ) regulations (Title 40 of the *Code of Federal Regulations*, Parts 1500 through 1508 [40 CFR Parts 1500–1508]; (2) DOE's National Environmental Policy Act (NEPA) implementing procedures at 10 CFR Part 1021; and (3) other applicable Federal statutes. In accordance with 40 CFR 1508.9(a) and 10 CFR 1021.321(b), this EA is intended to provide sufficient evidence and analysis to determine whether to prepare an environmental impact statement (EIS) or to issue a Finding of No Significant Impact (FONSI) for the Proposed Action.

1.1 Background

LANL is a multidisciplinary, multipurpose Federal laboratory that is primarily engaged in theoretical and experimental research and development activities and has limited responsibility for manufacturing nuclear weapons components. In addition to work supporting the missions of DOE and NNSA, LANL conducts work for other Federal agencies, such as the Department of Defense, as well as for university programs, institutions, and corporate entities.[4]

[3] MAR is the amount of radionuclides in grams or curies of activity that is available for release when acted upon by a given physical insult, stress, or accident.

[4] Refer to the *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2008a) for detailed information about LANL and its environmental setting, the missions of DOE and NNSA at LANL, and the activities performed at the site.

LANL is located in northern New Mexico, within Los Alamos County, which contains the two primary residential areas of Los Alamos and White Rock (**Figure 1**). It is about 60 miles north-northeast of Albuquerque, New Mexico, and about 25 miles northwest of Santa Fe, New Mexico. LANL occupies about 40 square miles of land on the eastern flank of the Jemez Mountains along the Pajarito Plateau. LANL is bordered by the Santa Fe National Forest to the north, west, and southeast; Bandelier National Monument to the east and southwest; and San Ildefonso Pueblo lands to the east. The terrain in this area of New Mexico generally consists of mesa tops and canyon bottoms trending in a west-to-east manner, with the canyons intersecting the Rio Grande to the east. The LANL site primarily consists of undeveloped grassland, shrubland, woodland, and forest. LANL operations are conducted within numerous facilities within Technical Areas (TAs), which are geographically distinct administrative units established for control of LANL operations. **Figure 2** shows the 47 contiguous TAs that comprise LANL.

AC and MC are fundamental capabilities required for the research and development support of DOE and NNSA missions at LANL (DOE 2003b). AC and MC capabilities have been available at LANL for the entire history of the site since the mid-1940s, generally at the CMR Building, and these capabilities remain critical to future work at the site. The CMR Building's nuclear operations and capabilities are restricted to maintain compliance with safety requirements (DOE 2003b). The building is not and cannot be operated to the full extent needed to meet future AC and MC operational requirements. This situation compels the need to consider actions to ensure the performance of all required AC and MC operations.

As part of ensuring a continuing capability for AC and MC operations, DOE/NNSA issued the *2015 CMRR SA* (DOE 2015a), which evaluated the environmental impacts of performing AC and MC operations at two existing LANL facilities in TA-55. One facility is the Hazard Category 2 PF-4, and the second is RLUOB, which contains laboratory and office space, training and operations centers, and an incident command center. This approach for ensuring continued AC and MC operations at LANL became viable because of changes made to the programs to be performed in PF-4, which enabled repurposing of laboratory space at PF-4 to support additional AC and MC operations. Furthermore, NNSA issued supplemental guidance (NNSA 2014) on the classification of nuclear facilities, based on updated parameters and analyses that increased the quantities of actinides allowed in a Radiological Facility to 38.6 grams of plutonium-239 equivalent (PuE)[5] (see the text box on page 5 and Chapter 2, Section 2.1). It thus became possible to provide AC and MC capabilities using a combination of laboratory space in TA-55 buildings: space that is already available in RLUOB and space to be made available in PF-4. NNSA proposed this modified approach for ensuring continued AC and MC capabilities and evaluated the environmental consequences of this modification in the *2015 CMRR SA*.

After further study and evaluation, NNSA has now identified a Proposed Action that would improve the use of laboratory space in TA-55. The Proposed Action would recategorize RLUOB from a Radiological Facility to a Hazard Category 3 Nuclear Facility with a limit on its MAR of 400 grams PuE (15 percent of the 2,610 grams of PuE allowed in a Hazard Category 3 Nuclear Facility). This would allow certain laboratory capabilities previously planned for PF-4 to be performed in RLUOB instead. Consequently, not as much space in PF-4 would be converted to AC and MC laboratory space. Fewer modifications to PF-4 would be required, with less generation of radioactive waste and fewer radiological exposures to workers performing the modifications. In contrast, the work to further modify RLUOB and install additional enclosures and equipment for the AC and MC work would occur in radiologically clean areas. Implementing the Proposed Action would not require changes to the structure of any TA-55 facility.

[5] For some facilities, the exact quantities of MAR, as well as the isotopic composition of some forms of plutonium, are sensitive from a security perspective. Many safety analyses have adopted the strategy of using a convenient surrogate, PuE, for the actual quantities, forms, and isotopic composition of the materials. PuE refers to quantities of different radionuclides on a common health-risk basis. The mass or radioactivity of other radionuclides is expressed in terms of the amount of plutonium-239 that would result in the same committed effective dose upon inhalation.

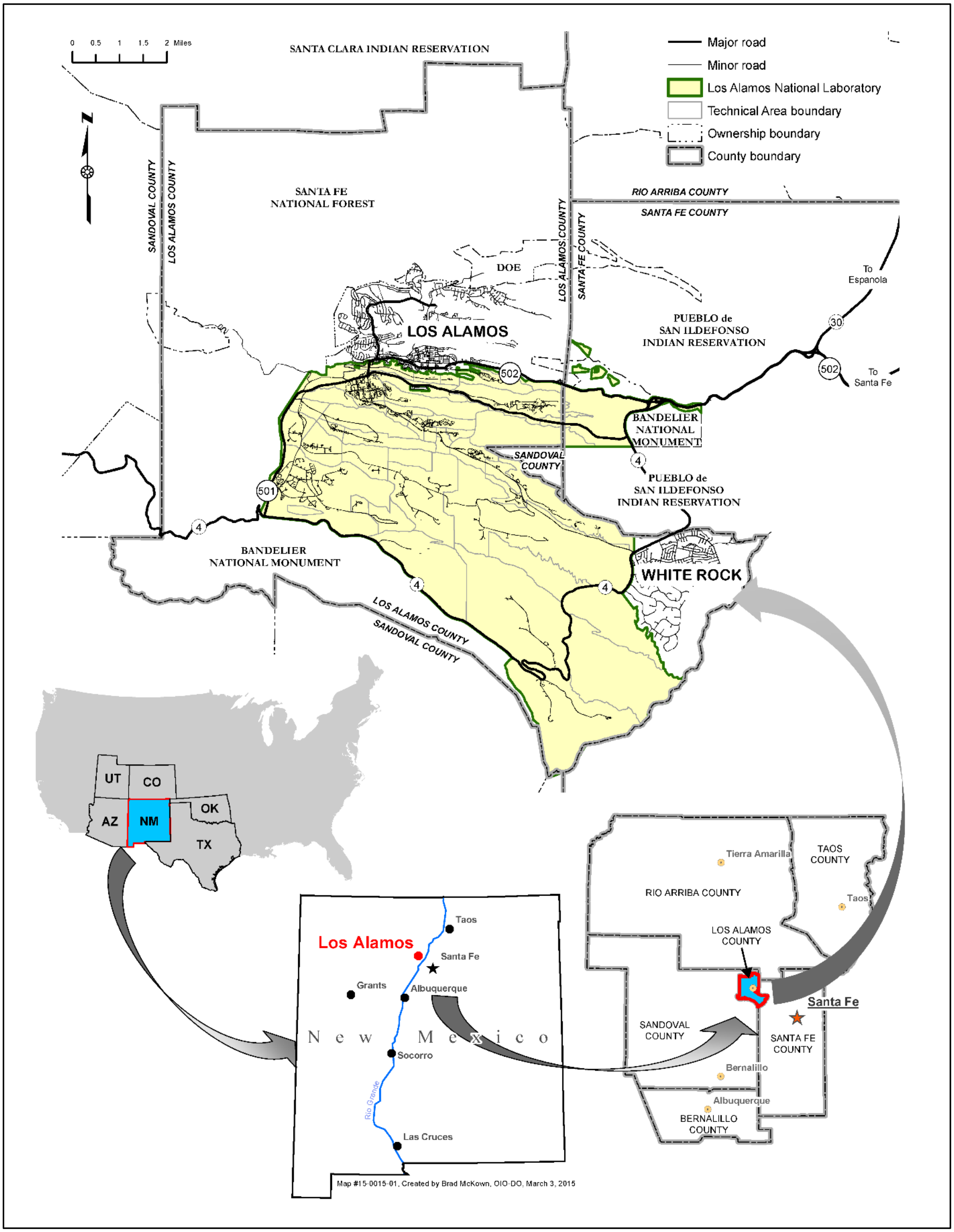

Figure 1. Location of Los Alamos National Laboratory

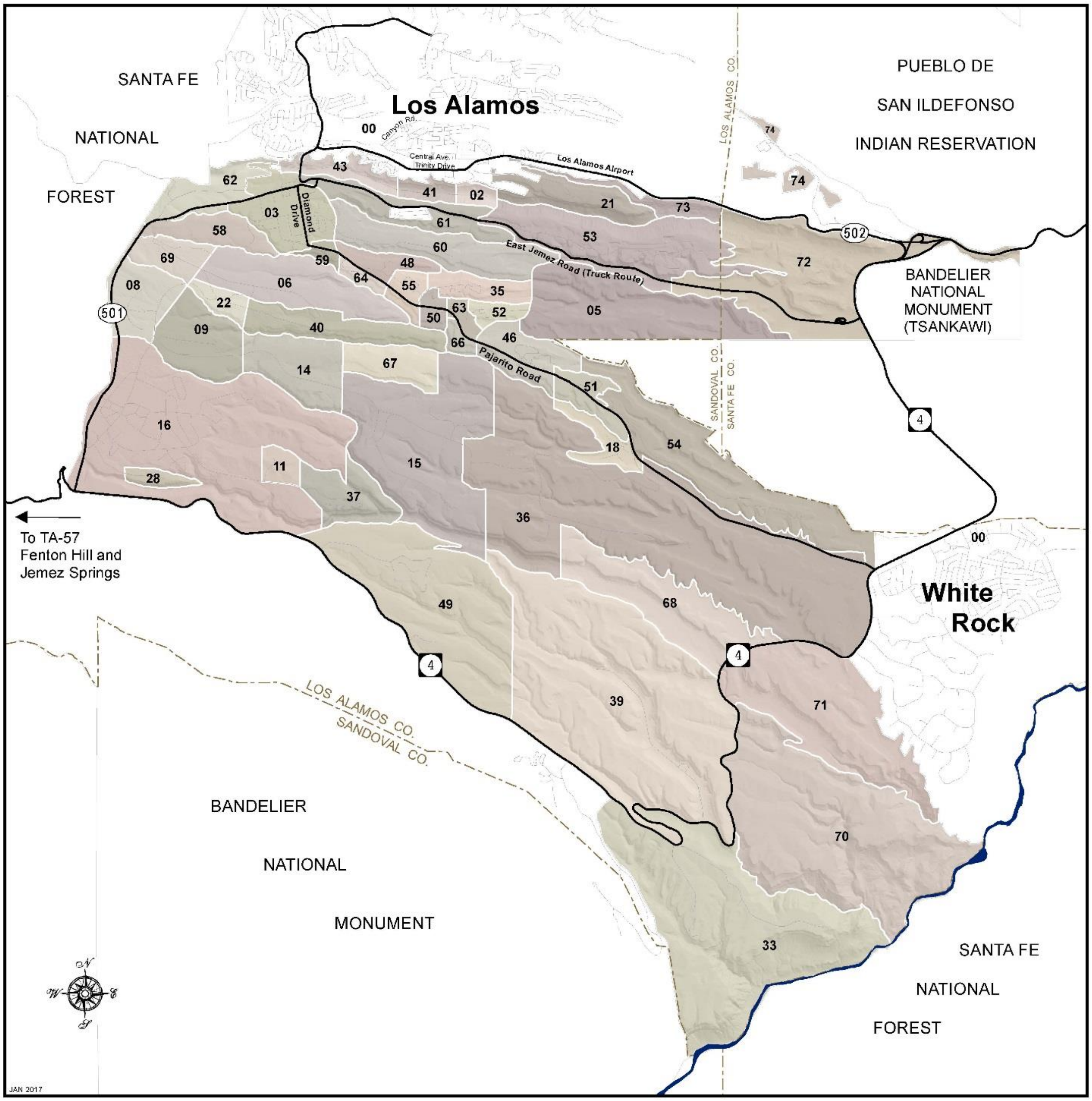

Figure 2. Identification and Location of Technical Areas Comprising Los Alamos National Laboratory

Hazard Categories

DOE assigns different hazard categories to its facilities in accordance with hazard analyses that consider the maximum potential injuries and fatalities in the event of a severe accident, without taking credit for designed safety features; administrative controls, other than limiting the total quantity of hazardous materials in the facility; or prompt emergency response. DOE has identified the following three nuclear hazard categories:

- *Hazard Category 1* – The hazard analysis shows the potential for significant offsite consequences. There are no facilities at LANL classified as Hazard Category 1 Nuclear Facilities.
- *Hazard Category 2* – The hazard analysis shows the potential for significant onsite consequences (facilities with the potential for nuclear criticality events or with sufficient quantities of hazardous materials and energy that would require onsite emergency planning activities).

  PF-4 is classified as a Hazard Category 2 Nuclear Facility.
- *Hazard Category 3* – The hazard analysis shows the potential for only significant localized consequences.

A facility that does not meet the threshold criteria of a Hazard Category 3 Nuclear Facility, but still possesses some amount of radioactive materials, is called a Radiological Facility. RLUOB is currently classified as a Radiological Facility.

DOE has determined threshold quantities (TQs) for individual radionuclides that define the lower boundaries for the hazard categories. For plutonium-239, the TQ for a Hazard Category 3 Nuclear Facility is 38.6 grams; the TQ for a Hazard Category 2 Nuclear Facility is 2,610 grams. Thus, a facility authorized to possess plutonium-239 in quantities less than 38.6 grams is a Radiological Facility. A facility authorized to possess plutonium-239 in quantities meeting or exceeding 38.6 grams, but less than 2,610 grams, is a Hazard Category 3 Nuclear Facility; and a facility authorized to possess plutonium-239 in quantities meeting or exceeding 2,610 grams is a Hazard Category 2 Nuclear Facility.

Sources: DOE 1992, 2008a; NNSA 2014.

1.2 Purpose and Need for Agency Action

The purpose and need for NNSA action, which has not changed since the 2003 issuance of the *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (*CMRR EIS*) (DOE/EIS-0350) (DOE 2003b), is to provide the physical means for accommodating continued AC and MC operations at LANL in a safe, secure, and environmentally sound manner that consolidates like activities (DOE 2003b). Consolidation of like activities enhances operational efficiency in terms of security, support, and risk reduction related to handling and transportation of nuclear materials.

1.3 Proposed Action

NNSA proposes to modify RLUOB to enable its operation as a MAR-limited, Hazard Category 3 Nuclear Facility, rather than a Radiological Facility, and to perform more AC and MC operations at RLUOB than the level evaluated in prior NEPA documentation. Consequently, NNSA would make fewer modifications to PF-4 (a Hazard Category 2 Nuclear Facility) and perform fewer AC and MC operations at PF-4 than those previously evaluated. Refer to Chapter 2, Section 2.1, to review the transition from DOE's decision to replace the CMR Building with RLUOB and the Chemistry and Metallurgy Research Building Replacement (CMRR) Nuclear Facility (CMRR-NF) to the Proposed Action to operate RLUOB as a MAR-limited Hazard Category 3 Nuclear Facility.

1.4 Scope of the Environmental Assessment

This EA evaluates two alternatives: (1) a Proposed Action Alternative reflecting a recategorization of RLUOB to a MAR-limited Hazard Category 3 Nuclear Facility, with more AC and MC operations conducted at RLUOB and fewer activities performed at PF-4 than those evaluated in the *2015 CMRR SA* (DOE 2015a), and (2) a No Action Alternative that would maintain RLUOB as a Radiological Facility, with AC and MC operations at RLUOB and PF-4 remaining consistent with those evaluated in the *2015 CMRR SA*.[6]

1.5 Related NEPA Documentation

The analysis in this EA relies in part on previous NEPA analyses that evaluated potential environmental impacts at LANL. This section provides a summary of NEPA documents related to the Proposed Action in this EA. A more detailed discussion of past plans and events that led to the current Proposed Action is presented in Chapter 2, Section 2.1.

In 2003, DOE prepared the *CMRR EIS* (DOE 2003b), which evaluated alternatives for replacing the AC and MC capabilities provided in the CMR Building. The CMRR project was to provide the physical means for conducting mission-critical CMR capabilities, to consolidate like activities for operational efficiency, and to potentially provide extra space for future modifications – for example, space for handling large vessels used to contain dynamic experiments (i.e., experiments that advance the understanding of the behavior of nuclear material subjected to extreme physical conditions). DOE subsequently issued a Record of Decision (ROD) (69 *Federal Register* [FR] 6967) for constructing and operating a two-building replacement for the CMR Building to be located in TA-55. These buildings were to consist of: (1) a building housing offices, classrooms, laboratories, and other facilities (now called RLUOB); and (2) a nuclear facility (CMRR-NF) housing Hazard Category 2 nuclear operations. RLUOB was constructed and is in operation; however, construction of CMRR-NF was initially delayed and subsequently cancelled (see below).

In January 2005, NNSA issued the *Supplement Analysis, Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement (CMRR) Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Changes to the Location of the CMRR Facility Components* (DOE/EIS-0350-SA-01) (DOE 2005). This supplement analysis (SA) evaluated the environmental impacts of changes to the first phase of the CMRR project by constructing the building now called RLUOB at one of two possible locations, which differed slightly from the locations evaluated in the *CMRR EIS;* one evaluated location was south of the intersection of Pajarito Road and Pecos Drive; the second was north of Pajarito Road. RLUOB was ultimately built at the location north of Pajarito Road.

In May 2008, NNSA issued the *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (*LANL SWEIS*) (DOE/EIS-0380) (DOE 2008a). The *LANL SWEIS* evaluated the potential environmental impacts from ongoing LANL operations and new activities, including a TA-55 Refurbishment (now called TA-55 Reinvestment) Project,[7] as well as an analysis of support activities related to construction of the CMRR project in addition to those evaluated in the *CMRR EIS* (DOE 2003b). The *LANL SWEIS* (DOE 2008a) stated that, although planning for RLUOB was complete, construction was underway, and planning for CMRR-NF had been initiated, CMRR-NF construction would not begin until NNSA had completed a programmatic NEPA document and made a decision on the organization of NNSA's nuclear enterprise. Following the 2008 publication of the *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement (Complex Transformation SPEIS)* (DOE/EIS-0236-S4) (DOE 2008b), NNSA issued two RODs (73 FR 77644, 73 FR 77656) that included decisions to retain plutonium operations at LANL and to proceed with construction and operation of CMRR-NF. In RODs for the

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[6] The analyses in this EA depend in part on other NEPA analyses prepared by DOE which are incorporated by reference into this EA and are listed in Appendix B.

[7] The TA-55 Reinvestment Project consists of a number of subprojects, including removal, replacement, and/or upgrade of gloveboxes, stands, chillers and coolers, air dryers, criticality safety alarm systems, confinement doors, water baths, stack monitors, uninterruptable power supplies, and fire alarm systems. Although most of the subprojects would occur indoors, implementation of several subprojects was expected to involve varying degrees of land-disturbing activities, including construction of accessory structures or additions to existing structures (DOE 2008a).

LANL SWEIS (73 FR 55840, 74 FR 33232), NNSA selected the No Action Alternative, including construction and operation of the CMRR project and the additional support activities evaluated under that alternative. NNSA also decided to implement the TA-55 Reinvestment Project to replace or upgrade obsolete or worn-out facility components and safety systems.

In 2011, NNSA issued the *Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico* (*CMRR-NF SEIS*) (DOE/EIS-0350-S1) (DOE 2011c), which evaluated the potential environmental impacts from revised alternatives for constructing and operating the CMRR-NF and from ancillary projects that had been proposed since publication of the *CMRR EIS*. In an October 18, 2011, amended ROD (76 FR 64344), NNSA selected the Modified CMRR-NF Alternative for constructing and operating the CMRR-NF portion of the CMRR project.

After publication of the *CMRR-NF SEIS* ROD, NNSA first announced a delay in construction of the CMRR-NF (DOE 2012a) and then cancelled it in the 2016 budget request (DOE 2015b). In this same time frame, other changes occurred that affected the options available to NNSA for providing needed AC and MC capabilities.

In January 2015, NNSA issued the *2015 CMRR SA* (DOE 2015a), which addressed proposed modifications to NNSA's approach for ensuring AC and MC capabilities at LANL by performing AC and MC work in RLUOB and in space to be made available at PF-4. Under these modifications, RLUOB would continue to operate as a Radiological Facility, but with an increased allowable quantity of actinides such as plutonium-239. NNSA determined that no additional NEPA documentation was needed to implement this modified approach.

1.6 Public Involvement

Given the level of public interest in NNSA's continuing efforts to consolidate AC and MC operations at LANL's TA-55, DOE is soliciting comments on the Draft EA during a 30-day public comment period. The Draft EA is available electronically on the DOE NEPA website (https://energy.gov/node/2501991). In addition, copies of the Draft EA were made available to the State of New Mexico and the governments of four accord Native American tribes,[8] and were placed in the following DOE public reading room:

Los Alamos National Laboratory Reading Room
94 Cities of Gold Road
Pojoaque, NM 87501
(505) 667-0216

Notification of the availability of the Draft EA for review and comment was provided on the LANL website and in newspapers in the vicinity of LANL.

[8] DOE has cooperative agreements (accords) with the Santa Clara Pueblo, Pueblo de Cochiti, Pueblo of Jemez, and Pueblo de San Ildefonso to develop and maintain environmental monitoring programs.

Comments on the Draft EA may be provided via the U.S. mail or email at the following addresses:

Opportunities for Public Comment	
By mail	NNSA Los Alamos Field Office ATTN: CMRR Project Management Office 3747 West Jemez Road Los Alamos, NM 87544
By email	RLUOBEA@HQ.DOE.GOV

All comments on the Draft EA provided within the 30-day comment period, beginning on the date of the public notice of availability, will be considered by NNSA as part of the preparation of the Final EA. The Final EA will include a summary of the comments received on the Draft EA, as well as NNSA's response to the comments. The Final EA will be made available on the DOE NEPA website (address provided above). Copies of the Final EA will be made available to the State of New Mexico and to the four accord pueblo governments, and placed in the DOE Reading Room at the location indicated above.

2.0 PROJECT BACKGROUND AND EVOLUTION

2.1 Changes to the CMRR Project

As discussed in Chapter 1, Section 1.1, although NNSA's AC and MC operations in support of stockpile stewardship have been performed at the CMR Building in TA-3 since the 1950s, the capabilities of and operations at the CMR Building are restricted due to safety constraints related mainly to the age of the facility. Consequently, DOE evaluated alternatives for replacing the CMR Building in the 2003 *CMRR EIS* (DOE 2003b), and issued a ROD (69 FR 6967; February 12, 2004) for constructing and operating the CMRR Facility in TA-55, consisting of RLUOB and the CMRR-NF, a Hazard Category 2 Nuclear Facility (see Section 1.5). Constructed and in operation, RLUOB is categorized as a Radiological Facility capable of handling less-than-Hazard Category 3 radioactive material, even though it was designed and constructed to more stringent requirements than those necessary for a Radiological Facility (see Section 2.3.1). As a Radiological Facility under DOE guidance at the time of the *CMRR EIS*, RLUOB was authorized to house up to 8.4 grams PuE.

DOE evaluated additional alternatives for constructing and operating the CMRR-NF in the 2011 *CMRR-NF SEIS* (DOE 2011c); in an amended ROD (76 FR 64344; October 18, 2011), DOE selected the Modified CMRR-NF Alternative for constructing and operating CMRR-NF. In addition to alternatives evaluated in detail, the *CMRR-NF SEIS* considered alternatives that were determined not to be reasonable and thus were not carried forward and evaluated in detail, including upgrades to the CMR Building and an alternative whereby AC and MC capabilities would be distributed among multiple LANL facilities. To implement the latter alternative, a Hazard Category 2 Nuclear Facility, such as PF-4 in TA-55, would be required for some AC and MC work. PF-4 was considered for this work, but it was determined at that time that using the space and capabilities at PF-4 would interfere with other ongoing work and reduce the availability of facility space for future expected DOE and NNSA mission support work. LANL Hazard Category 2 Nuclear Facilities outside of TA-55 were considered, but were determined to not be reasonable options for a variety of reasons, particularly a lack of available space or required engineered safety controls, so their use would introduce new hazards for which the facilities were not designed.[9] In addition, use of facilities in other LANL locations would not conform to the objective of collocating plutonium operations near PF-4 and would require periodic closure of roadways and heightened security to enable transfer of materials between the facilities. NNSA also evaluated whether a combination of space at PF-4 and RLUOB could be used, but dismissed this combination alternative from detailed evaluation because of limits on the quantities of MAR allowed in RLUOB (8.4 grams PuE) and the expected lack of space at PF-4, as discussed above (DOE 2011c).

Since publication of the 2004 *CMRR EIS* ROD (69 FR 6967) and 2011 *CMRR-NF SEIS*, construction of CMRR-NF was delayed and then cancelled (DOE 2015b). However, expected PF-4 programs and technical changes made it possible to provide the necessary AC and MC capabilities using a combination of space already available in RLUOB and space to be made available in PF-4. These changes are summarized below:

- *PF-4 Programs*. Changes in programs to be performed at PF-4 enabled repurposing of existing laboratory space at this facility to support additional AC and MC operations. Program changes included a different approach in the experimental strategy for the weapons certification program and elimination of the need for a nuclear ceramic fuels capability using plutonium ceramics. In addition, additional space could be made available by consolidating operations for chemical

[9] Other reasons included: (1) they had been decommissioned for safety and security reasons and were no longer considered Hazard Category 2 Nuclear Facilities; (2) they were closure sites (specifically, environmental cleanup potential release sites); or (3) they were support facilities lacking the necessary space to perform AC and MC operations (e.g., waste management facilities) (DOE 2011).

recovery and purification of plutonium from residues into a more efficient configuration and removing unused legacy equipment.

- *Technical.* In response to NNSA guidance on the use of updated radionuclide dosimetry information and accident release fractions when establishing the hazard category of a nuclear facility, as required in 10 CFR Part 830.202(b)(3), Nuclear Safety Management, Safety Basis Requirements (NNSA 2014), threshold quantities (TQs)[10] at NNSA nuclear facilities were re-evaluated. Although the TQs for some radionuclides were reduced pursuant to the guidance, the TQs for others, including plutonium-239, were raised. Because the TQ for plutonium-239 in a Hazard Category 3 Nuclear Facility was changed from 8.4 grams to 38.6 grams, up to 38.6 grams of plutonium-239 could be contained within a Radiological Facility. This change in TQs is a function of an enhanced understanding of dosimetry[11] and revised accident release fractions. That is, the health risk associated with 8.4 grams of plutonium-239, as calculated using the previous dosimetry and accident release fractions, yields the same health risk as 38.6 grams of plutonium-239, as calculated using the updated dosimetry and accident release fractions. NNSA has approved the use of updated TQs at LANL; consequently, up to 38.6 grams PuE can be contained within RLUOB in accordance with its categorization as a Radiological Facility.

Continued examination indicated that RLUOB could be safely recategorized as a Hazard Category 3 Nuclear Facility with a limiting PuE quantity of 400 grams, so that additional AC and MC work could be performed in RLUOB compared to that evaluated in the *2015 CMRR SA* (DOE 2015a), with less AC and MC work performed in PF-4. By relocating several AC and MC capabilities into RLUOB rather than PF-4, fewer facility modifications would be required in PF-4. Work to modify PF-4, including equipment installation, would be performed in a facility that has been operating radiologically for decades, while work at RLUOB would be performed in nonradiological ("clean") areas. In addition, work to modify PF-4 would require removal or modification of some existing equipment (including equipment contaminated with radionuclides or hazardous constituents) before the installation of new equipment, while work to modify RLUOB would essentially consist of installation of new equipment in empty, never used, work spaces. Thus, the overall time required to modify RLUOB and PF-4 to provide the needed AC and MC capabilities would be shorter. In addition, NNSA expects that other impacts associated with facility modifications would be lower overall, such as radiation exposures to workers and generation of radioactive waste. Furthermore, NNSA expects that radiation exposures among workers performing AC and MC operations would be lower due to the lower overall radiation environment at RLUOB compared to that at PF-4. Finally, performing low-MAR, low-risk AC and MC operations at RLUOB rather than PF-4 would improve operational efficiency and reduce the costs for these activities, as well as free valuable PF-4 laboratory space for other activities involving larger quantities of nuclear material.

NNSA proposes to upgrade the PuE limit for RLUOB to 400 grams because this increase is expected to be:

- Sufficient for the combined RLUOB and PF-4 capabilities to satisfy anticipated programmatic needs for AC and MC; and
- Accomplished in a manner ensuring the safety of workers and members of the public without requiring modifications to the RLUOB or PF-4 structure or safety systems.

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[10] Nuclear and radiological facilities at LANL are identified by a hazard category in accordance with the potential consequences in the event of an accident (10 CFR Part 830). Radionuclide TQs define the lower boundaries for classification of nuclear facilities. In this example, 38.6 grams of plutonium-239 is the TQ for classifying a facility as a Hazard Category 3 Nuclear Facility; facilities such as RLUOB that are authorized to contain plutonium-239 in quantities up to, but not equaling or exceeding 38.6 grams, are categorized as Radiological Facilities.

[11] On June 8, 2007, DOE promulgated amendments to 10 CFR 835, Occupational Radiation Protection, to incorporate (among other revised requirements) updated dosimetric models and radiation dose terms (72 FR 31905).

The following factors were considered in arriving at the proposed 400-gram PuE inventory limit:

- Based on the levels of impacts on the public and noninvolved workers[12] from a preliminary analysis of a hypothetical unmitigated maximum reasonably foreseeable accident in the *Response to Data Call for NEPA Environmental Assessment: Proposed Physical and Operational Changes for Analytical Chemistry and Materials Characterization at the Radiological Laboratory Utility Office Building* (*LANL Data Call Response*) (LANL 2018), NNSA does not expect that structures, systems, and components at RLUOB would need to be designated as safety class. Only inventory controls would need to be designated safety significant.[13]
- The limit would not require physical and operational security requirements comparable to those in place for PF-4.
- The limit would be less than the quantity of plutonium needed for a plutonium nuclear criticality event to occur.

Therefore, NNSA expects that the Proposed Action would ensure the safe continuance of AC and MC capabilities at LANL.

2.2 RLUOB Material at Risk

Under the Proposed Action, RLUOB would become a Hazard Category 3 Nuclear Facility, but would have a safety basis limitation on the amount of MAR permitted in the facility. That limit of 400 grams PuE is smaller than the limit of up to 2,610 grams PuE allowed in a Hazard Category 3 Nuclear Facility.

To increase the MAR above 400 grams PuE, significant changes would be required by DOE security and safety requirements. Under the DOE graded approach to nuclear security safeguards, the level of physical security and nuclear material control and accountability varies with the quantity and "attractiveness" of the nuclear material (see text box). RLUOB could maintain a Safeguards Category III status for nuclear material safeguards as long as the plutonium inventory was maintained at or less than 400 grams. If the plutonium inventory were to exceed 400 grams, much more elaborate and expensive physical and operational security requirements would be required, much like those at PF-4.[14] In accordance with DOE Order 474.2, Change 4, *Nuclear Material Control and Accountability* (DOE 2011b), the operational requirements for a Safeguards Category III facility are less than those for a Safeguards Category I or II facility. PF-4 is a Security Category I facility.

An increase in the plutonium limit above 400 grams PuE would also require changes in the safety basis for the facility. Whereas RLUOB can operate as a Hazard Category 3 Nuclear Facility with a limit of 400 grams PuE, a limit above that level would require thorough review of the facility and its operations to identify the systems, structures, and components that are most important to safety. An inventory limit exceeding 400 grams PuE would likely require additional administrative and physical controls to preclude the potential for a nuclear

Safeguards Categories

DOE uses a cost-effective, graded approach to provide special nuclear material safeguards and security. Quantities of special nuclear material stored at each DOE site are categorized into Safeguards Categories I, II, III, and IV, with the greatest quantities included under Safeguards Category I, and lesser quantities included in descending order under Safeguards Categories II through IV.

Source: DOE 2011b.

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[12] A definition of a noninvolved worker is provided in Chapter 4, Section 4.1.

[13] "*Safety class structures, systems, and components* means the structures, systems, or components, including portions of process systems, whose preventative or mitigative function is necessary to limit radioactive hazardous material exposure to the public, as determined from safety analyses." … "*Safety significant structures, systems, and components* means the structures, systems, and components which are not designated as safety class structures, systems, and components, but whose preventative or mitigative function is a major contributor to defense in depth and/or worker safety as determined from safety analyses." (10 CFR 830.3, Definitions).

[14] An example additional security requirement would be to install and operate a perimeter intrusion, detection, assessment, and delay system.

criticality accident, as well as additional safety equipment such as nuclear criticality alarm systems. A preliminary analysis indicates that, with an inventory limit of 400 grams PuE, none of the current safety systems, such as building ventilation, would require designation as safety class or safety significant to meet DOE requirements (LANL 2018). If the inventory limit were larger than 400 grams PuE, structures, systems, and components may be identified as significant to safety performance and require redesign and upgrading. Such systems would be subject to more stringent requirements for construction, inspection, and maintenance.

An increase in the allowable quantity of MAR above 400 grams PuE would also trigger the need for a documented safety analysis to be prepared and approved for RLUOB. Such a multi-year process would involve identifying, analyzing, and documenting a range of accidents that could occur at the facility. Because a larger quantity of MAR would mean that the potential impacts to noninvolved workers and the public could be greater, existing engineered controls may need to be credited, and new engineered controls may need to be added to mitigate potential impacts. Any additional administrative controls to ensure safe operations would need to be incorporated into facility procedures. After the documented safety analysis was prepared, it would be subject to a thorough review and approval process by NNSA.

2.3 Relevant Facilities

2.3.1 RLUOB

Completed in 2011, RLUOB provides about 19,500 square feet of laboratory space, office space to support 350 personnel, a training center, an operations center, and a facility incident command center (NNSA 2016a). The RLUOB structure and equipment anchorages in radiological spaces meet the requirements for Seismic Performance Category 2, as provided in *DOE Standard – Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities* DOE-STD-1020-2002 (DOE 2002),[15] while the remainder of the facility meets the requirements of Seismic Performance Category 1[16] (LANL 2018).

Because RLUOB is a multi-purpose facility, it has its own heating, ventilation, and air-conditioning (HVAC) system to support office occupancy, as well as a separate laboratory HVAC system to support laboratory operations. The laboratory HVAC system is complex and encompasses three levels of confinement barriers, identified as Zone 1, Zone 2, and Zone 3:

Zone 1 – primary confinement system which includes the glovebox enclosures and associated exhaust systems.

Zone 2 – secondary confinement system which includes the walls, floor, ceiling, and doors of the laboratories, including hoods and open-front enclosures.

Zone 3 – additional confinement barrier which includes the walls, floors, ceilings, and doors of the corridor or space that surrounds the laboratory.

The flow of air is from areas of lower to higher contamination potential (i.e., Zone 3 to Zone 2 to Zone 1). Exhaust air from Zone 1 (including air from glovebox enclosures) passes through a certified high-efficiency particulate air (HEPA) filtration system with fire protection before release to the atmosphere through a stack. Zone 2 handles a much larger air volume and exhausts air from laboratory hoods and open-front enclosures, the laboratory room, and laboratory support rooms. The Zone 2 exhaust system

[15] This standard, in place at the time of the RLUOB design, was replaced by DOE-STD-1020-2012 (DOE 2012b).

[16] Each structure, system, and component in a DOE facility is assigned to one of five performance categories (PCs), depending on its safety importance. For PC-1 structures, systems, and components, the primary concern is preventing major structural damage, collapse, or other failure that would endanger personnel (life safety). A PC-2 structure, system, and component designation is meant to ensure the operability of essential facilities or to prevent physical injury to in-facility workers. PC-2 structures, systems, and components should result in limited structural damage from design-basis natural phenomena events (such as an earthquake) to ensure minimal interruption of facility operation and repair following such an event (DOE 1993).

comprises a separate certified HEPA filtration system with fire protection that exhausts directly to the same stack. Stack emissions are monitored to record radiation releases, if any, and to provide data for regulatory compliance determinations. The Zone 3 system provides makeup air to Zone 2 and runs at a negative pressure relative to the outside air and a positive pressure relative to Zone 2 to ensure contamination control. Supply air to the laboratories is filtered and humidity-controlled (LANL 2018).

The laboratories where the AC and MC work would be done are built in a modular fashion, with each basic unit having approximately 750 square feet of floor space. The modules are outfitted with connections for utilities, such as instrument air and laboratory gases, as well as fire-suppression sprinklers. Continuous air monitors and fixed-head air samplers are also installed. Liquid radioactive waste from the laboratories is collected in tanks and tested before being pumped to the Radioactive Liquid Waste Treatment Facility (RLWTF) in TA-50. Capabilities are in place to perform nondestructive analysis and other radioactive waste characterization and verification activities, in compliance with disposal facility waste acceptance criteria, and to provide temporary storage and staging of radioactive and hazardous wastes pending their disposition (LANL 2018).

RLUOB was designed to provide utilities to both RLUOB and the canceled CMRR-NF. RLUOB is equipped with state-of-the-art systems to monitor and control (via the operations center) all instrumented facility systems via real-time digital sensors, including laboratory HVAC temperature and humidity. In addition, RLUOB contains a facility incident center with video and audio links with the LANL central emergency operations center in TA-69 (LANL 2018).

Electric power, water, heat, compressed air, backup power, and other services are provided by utility equipment housed in a physically separate Central Utility Building that was sized to support both RLUOB and the unconstructed CMRR-NF, although support equipment specific to the CMRR-NF was never installed. Three diesel generators outside of the Central Utility Building can supply electric power in the event of emergencies (LANL 2018).

2.3.2 Plutonium Facility Complex

The Plutonium Facility Complex in TA-55 conducts a variety of activities, including basic and applied research in plutonium and actinide chemistry; nuclear materials separation, processing, and recovery; plutonium metallurgy, preparation, casting, fabrication, and recovery; machining and metallurgy; and destructive and nondestructive analysis (NNSA 2016b). The Plutonium Facility Complex consists of five connected buildings consisting of the main plutonium processing facility, PF-4, as well as buildings for administration, technical and office support, and warehousing. PF-4 has operated since April 1978 and employs about 1,000 LANL and subcontractor personnel (NNSA 2012). PF-4 supports LANL plutonium pit manufacturing and surveillance programs, including metal preparation and recovery operations. Plutonium experiments at PF-4 support the nation's stockpile assessment without the need to conduct actual nuclear tests (NNSA 2016b). A double security fence surrounds PF-4.

PF-4 was built to comply with the contemporary seismic standards for a Hazard Category 1 Nuclear Facility, but is categorized as a Hazard Category 2 Nuclear Facility (DOE 2008a). In consideration of concerns raised by the independent Defense Nuclear Facilities Safety Board (DNFSB) regarding PF-4 performance in the event of a strong earthquake, DOE has undertaken several actions over the past several years to enhance the safety configuration at PF-4, including upgrading the building's structure and confinement system to withstand design-basis earthquakes, improvements to the building's fire-suppression systems, and additional seismic and safety analyses (DOE 2015a).

The Plutonium Facility Complex includes capabilities to manage radioactive and nonradioactive wastes generated from activities therein.[17] Transuranic (TRU) waste storage capabilities were recently increased

[17] Definitions of the radioactive and nonradioactive wastes to be generated under the alternatives evaluated in this EA are provided in Chapter 4, Section 4.3.1.

from 400 to 1,200 55-gallon drum equivalents. TRU waste characterization capabilities have been installed at TA-55, including nondestructive analysis, flammable gas testing, visual examination, and real-time radiography equipment (LANL 2018). TA-55 also has the capability to load TRU waste containers into Transuranic Package Transporter (TRUPACT) packaging for shipment to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico (NA-LA 2017) (see Section 4.3.1).

Ongoing PF-4 facility upgrades and seismic analyses are independent of the alternatives evaluated in this EA. Activities to remove and replace gloveboxes, other enclosures, and equipment at PF-4 would not prevent or degrade any of the facility upgrades. Activity scheduling would minimize any conflicts. As addressed in Chapter 4, Section 4.2.1.2, the AC and MC operations to be performed at PF-4 would not increase MAR in PF-4 or the source terms associated with seismically induced PF-4 accidents.

2.3.3 Primary Support Facilities Outside of TA-55

The actions addressed in this EA would be supported by waste management facilities and capabilities located outside of TA-55. As addressed in Chapter 4, Section 4.3.2, capabilities in TA-54 would be used to process enclosures and other equipment removed during PF-4 modifications to reduce waste volumes and to separate TRU waste from low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW). Temporary storage of TRU waste may occur at the TRU Waste Facility in TA-63 (DOE 2015a).[18] The TRU Waste Facility may also be used to load TRU waste into TRUPACT packaging for shipment to WIPP.[19] Temporary staging of MLLW or chemical waste could occur in Area L of TA-54 pending shipment off site for treatment or disposal (LANL 2018).

Any radioactive liquid waste generated during facility modifications or AC and MC operations would be managed at the RLWTF in TA-50. Sanitary waste would be managed at the Sanitary Wastewater Systems Plant in TA-46.

[18] In its September 26, 2008, ROD (73 FR 55833), DOE decided to construct and operate the TRU Waste Facility as part of the Waste Management Facilities Transition Projects evaluated in the *LANL SWEIS* (DOE 2008a).

[19] Loading of TRU waste into TRUPACT packaging for shipment to WIPP could also occur at the Radioassay and Nondestructive Testing Facility in TA-54.

3.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

This chapter describes the Proposed Action and a No Action Alternative and identifies those actions that would be common to both alternatives and those that would be different between the alternatives. In addition, alternatives considered but eliminated from further detailed analysis and the reasons for these decisions are addressed.

As evaluated in the *2015 CMRR SA* (DOE 2015a), a number of actions would be performed to support modifications and equipment installation in RLUOB and PF-4. These actions are common to both the Proposed Action and the No Action Alternative. Because they were previously evaluated in the *2015 CMRR SA* (in some cases, they have been completed) and there would be no meaningful difference in the actions between the current Proposed Action and No Action Alternatives, they are not evaluated in detail in this EA. These actions include providing temporary construction support trailers and storage structures within previously disturbed areas in convenient proximities to RLUOB and PF-4. Several freight containers may be temporarily installed in TA-55 to store equipment or to support subcontractors. In addition to the temporary construction facilities, some permanent changes were evaluated in the *2015 CMRR SA*. Additional office and warehouse space is being developed to support activities in RLUOB and PF-4. Facility modifications in RLUOB were implemented to provide an indoor construction staging area and to reconfigure security and radiological control boundaries to facilitate laboratory access by workers that are involved in laboratory modifications. What was originally planned as part of a tunnel extending from RLUOB to the cancelled CMRR-NF was modified to serve as an entrance to RLUOB on the laboratory floor level. This entrance enables efficient entry and egress of facility modification workers and equipment. In support of work in PF-4, modifications in common among the Proposed Action and No Action Alternatives include an indoor construction support area, additional shower and locker room space, and a reconfigured PF-4 entry and egress control area in an adjacent and connected building. Existing space within PF-3 (an existing TA-55 building inside the protected area) may be modified to provide temporary office space.

Factors Considered in Establishing the 400 Grams of PuE Material-at-Risk Limit

1. The maximum reasonably foreseeable accident is not expected to result in unmitigated public and noninvolved worker radiological doses greater than regulatory limits (1 roentgen equivalent man [rem] and 5 rem, respectively); therefore, no structures, systems, and components would need to be designated safety class or safety significant.
2. The inventory would not exceed the 400-gram threshold quantity for Security Category III levels of plutonium, so no perimeter intrusion, detection, assessment, and delay system would be required.
3. The inventory would not exceed the approximately 450-gram threshold quantity for plutonium nuclear criticality, so no criticality alarms or additional criticality safety controls would be required.
4. Source: LANL 2018.

3.1 Proposed Action – Operate RLUOB as a MAR-Limited, Hazard Category 3 Nuclear Facility and Modify PF-4

NNSA proposes administrative and physical changes to recategorize RLUOB from a Radiological Facility, allowing up to 38.6 grams PuE,[20] to a MAR-limited, Hazard Category 3 Nuclear Facility, allowing up to 400 grams PuE. This re-categorization would allow installation of a greater number of AC and MC capabilities at RLUOB instead of at PF-4, as currently planned and evaluated for the No Action Alternative. The Proposed Action Alternative would maximize use of RLUOB laboratory space for AC and MC operations and require less laboratory space in PF-4. The proposed additional changes for RLUOB include outfitting and refurbishing approximately

[20] The term plutonium-239 equivalent (PuE) is used in this EA to refer to quantities of different radionuclides on a common health-risk basis. The mass or radioactivity of other radionuclides is expressed in terms of the amount of plutonium-239 that would result in the same committed effective dose upon inhalation.

3,000 square feet of unequipped laboratory space with enclosures and AC and MC equipment; no space would be retained as contingency space for other activities. Activities requiring quantities of radioactive material greater than those allowed in RLUOB laboratories would still need to be performed in PF-4.

Since publication of the ROD for the *CMRR-NF SEIS* (76 FR 64344) in 2011, changes have been made to mission needs and expected PF-4 programs (see Chapter 2, Section 2.1). The CMRR-NF was delayed (DOE 2012a) and then cancelled (DOE 2015b), and in accordance with NNSA guidance (NNSA 2014), NNSA increased the quantity of nuclear material allowed in a Radiological Facility to up to 38.6 grams PuE. These changes contributed to the need for the *2015 CMRR SA* (DOE 2015a) that evaluated providing the necessary AC and MC capabilities using a combination of space already available in RLUOB and space to be made available at PF-4. The Proposed Action from the *2015 CMRR SA* is the No Action Alternative in this EA (see Section 3.2).

Building on the changes analyzed in the *2015 CMRR SA*, NNSA determined that RLUOB could be operated as a MAR-limited Hazard Category 3 Nuclear Facility, allowing 400 grams PuE in RLUOB. NNSA proposes to further outfit available laboratory space in RLUOB for AC and MC operations by installing equipment in approximately 3,000 square feet of empty laboratory rooms and modifying existing laboratory rooms. In PF-4, NNSA proposes to adjust existing laboratory space for AC and MC operations that require quantities of radiological materials greater than that allowed in RLUOB laboratories. Equipment in some laboratory rooms would be removed, and new equipment would be installed or existing equipment reconfigured. **Figure 3** provides a southeasterly view of TA-55 showing the location of RLUOB and PF-4.

Figure 3. TA-55 and Vicinity

3.1.1 RLUOB Modifications

Table 1 provides key construction parameters for the Proposed Action and the No Action Alternatives. The proposed modifications to RLUOB would result in additional laboratory capabilities installed in existing building space under both alternatives. These capabilities would be provided by installing new ventilated enclosures with accompanying instrumentation and ancillary equipment. Under the Proposed Action, the first phase of modification and refitting of RLUOB would be the same as the No Action Alternative; these activities are underway and are scheduled to be completed in approximately 3 to 5 years (DOE 2015a). The AC and MC capabilities to be relocated to RLUOB during phase 1 would be the same as those under the No Action Alternative and would include radiochemistry, trace-element analysis, mass spectrometry, sample preparation and distribution, assay, AC and MC research and development, and support operations.

Table 1. Key Construction Parameters for the Alternatives

Parameter		***Proposed Action Alternative* [a]**	***No Action Alternative* [b]**
Space Modified (square feet)	RLUOB	13,000	10,000
	PF-4	5,400	7,000
Ventilated Enclosures [c]	Installed in RLUOB	109	81
	Removed from PF-4	41	55
	Modified in PF-4	29	30
	Installed in PF-4	30	43
Employment (FTEs) (peak)		480 [d]	480
Radiation Workers (peak)		150 [d]	150 [e]
Waste Generated (cubic feet)	TRU waste	3,030 [f]	3,520
	LLW	4,760 [f]	6,150
	MLLW	3,460 [f]	5,440

FTE = full-time equivalent; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; PF-4 = Plutonium Facility, Building 4; RLUOB = Radiological Laboratory/Utility /Office Building; TRU = transuranic.

[a] Source: LANL 2018, except where otherwise indicated.

[b] Source: DOE 2015a, except where otherwise indicated.

[c] Ventilated enclosures include glovebox enclosures, open-front enclosures, and hoods.

[d] Assumed for analysis; overall, there could be a small decrease in the number of construction workers under the Proposed Action Alternative (LANL 2018).

[e] Source: LANL 2015a.

[f] Waste from removal of ventilated enclosures is conservative. Removed ventilated enclosures might be size-reduced before being sent off site for disposal.

Under the Proposed Action, the second and final phase would install additional AC and MC capabilities at RLUOB that are slated for PF-4 under the No Action Alternative, including plutonium assay, x-ray analysis, plasma spectroscopy, MC synthesis, material compatibility and coupon hydriding, waste management and nondestructive assay measurements, and some MC activities, such as transmission electron microscopy and scanning electron microscopy (LANL 2018). The second phase would be completed in approximately 4 to 7 years, subject to funding (LANL 2018).

Except for small quantities of solid LLW (e.g., personal protective gear) that could result from connecting new equipment to existing liquid radioactive waste drain lines and ventilation systems, waste generated from RLUOB modifications would consist of nonhazardous construction debris such as empty crates and boxes and pipe sections and fittings. Very small quantities of hazardous waste could be generated. These wastes would be managed using established practices.

3.1.2 PF-4 Modifications

Reconfiguration of PF-4 would require removal of some ventilated enclosures, equipment, and materials; reconfiguration of some enclosures; and installation of new enclosures, instrumentation, and ancillary equipment. Modification and refitting of PF-4 would be completed in approximately 7 years, subject to funding (LANL 2018).

Under the Proposed Action Alternative, the need to install new gloveboxes and programmatic equipment in PF-4 would be eliminated versus the No Action Alternative. Correspondingly, predecessor activities, such as relocation of existing programmatic operations to other PF-4 rooms and decontamination and decommissioning of some equipment would not occur (LANL 2018).

To the extent possible, LLW and MLLW from facility modifications and equipment installation would be characterized and packaged at the Hazardous Material Storage Area in TA-55 before being shipped off site for disposal. However, much of the radioactively contaminated enclosures, equipment, and materials removed from PF-4 would be staged in a waste management area within TA-55 to await transfer to TA-54 for decontamination and size reduction to enable characterization, packaging, and disposal as LLW or MLLW. The decontamination process would generate TRU waste that would be packaged, characterized, and stored, pending certification and shipment for disposal at WIPP. Waste management operations would be consistent with the safety-basis limits established for the affected facilities. PF-4 modifications could generate a small quantity of chemical waste,[21] as well as nonhazardous waste (e.g., construction and demolition debris) and sanitary waste. These wastes would be managed using established practices.

3.1.3 Operations

Under the Proposed Action Alternative, RLUOB would be operated as a MAR-limited Hazard Category 3 Nuclear Facility, allowing 400 grams PuE. AC and MC operations requiring quantities of radioactive materials greater than those allowed in RLUOB laboratories would be conducted in reconfigured space within PF-4. **Table 2** summarizes the key operating parameters for the Proposed Action Alternative.

Under the Proposed Action Alternative, AC and MC operations would involve an estimated 135 radiation workers at RLUOB and 48 radiation workers at PF-4. Most workers would come from existing jobs at the CMR Building, RLUOB, and PF-4. Approximately 30 full-time equivalent (FTE) staff would be new employees. Workers in PF-4 would be exposed to higher doses than workers in RLUOB because PF-4 is an active plutonium production facility that has operated since 1978, and larger quantities of radioactive materials are used in the facility.

Gaseous process emissions from RLUOB and PF-4 would pass through HEPA filters before discharge to the atmosphere. Radionuclide emissions from RLUOB and PF-4 would be no more than those listed in Table 2. The majority of the emissions from PF-4 would be associated with other missions involving plutonium; AC and MC operations would result in a small percentage of the total emissions from PF-4 and may not be detectable over the baseline emissions.

Radioactive and chemical wastes would be generated largely from sample preparation and disposal, empty containers and laboratory glassware, spent filters, and personal protective equipment. Nearly all operational TRU waste would arise from AC and MC operations at PF-4. The annual quantity of sanitary waste would be smaller than that estimated in the *CMRR EIS* (DOE 2003b) because fewer operational personnel would be required than was projected in the EIS. Operational wastes would be managed using established practices.

[21] Chemical waste is not a formal LANL waste category, but denotes a broad category of materials, including hazardous waste regulated under the Resource Conservation and Recovery Act, toxic waste regulated under the Toxic Substances Control Act, and special waste designated under New Mexico Solid Waste Regulations.

Table 2. Key Operations Parameters for the Alternatives

Parameter		*Proposed Action* [a]	*No Action Alternative* [b]
New Employment (FTEs)	RLUOB and PF-4	30 [c]	
Radiation Workers	RLUOB	135	100
	PF-4	48	60
Radionuclide Emissions (curies per year)[d]	PuE	7.6×10^{-4}	
	Tritium (elemental)	250	
	Tritium (water vapor)	750	
	Krypton-85	100	
	Xenon-131m	45	
	Xenon-133	1,500	
Annual Waste Generation [e]	TRU waste (cubic feet)	2,370	
	LLW (cubic feet)	71,280	
	MLLW (cubic feet)	700	
	Hazardous waste (pounds)	24,700	
	Sanitary waste (gallons)	390,000	

FTE = full-time equivalent; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; PF-4 = Plutonium Facility, Building 4; PuE = plutonium-239 equivalent; RLUOB = Radiological Laboratory/Utility/Office Building; TRU = transuranic.

[a] Source: LANL 2018.

[b] Source: DOE 2015a, except where otherwise indicated.

[c] The value represents projected additional hires. Most workers performing AC and MC operations under both alternatives would be existing workers at RLUOB and PF-4 or transferred from other LANL locations such as the CMR Building.

[d] Source: DOE 2015a; LANL 2018. For analysis, it was assumed that all emissions from AC and MC operations would occur from RLUOB under the Proposed Action Alternative and from PF-4 under the No Action Alternative.

[e] It was assumed that essentially the same waste generation would occur under both alternatives because the same AC and MC operations would take place under both alternatives.

3.2 No Action Alternative – Operate RLUOB as a Radiological Facility and Modify PF-4

Under the No Action Alternative and as evaluated in the *2015 CMRR SA* (DOE 2015a), NNSA would transfer AC and MC capabilities from the CMR Building to RLUOB and PF-4. In this regard, the No Action Alternative would be similar to the Proposed Action. The difference would be in the smaller amount of material allowed in RLUOB under the No Action Alternative (up to 38.6 grams PuE) and the extent of modification required to RLUOB (less than under the Proposed Action Alternative) and PF-4 (more than under the Proposed Action Alternative).

3.2.1 RLUOB Modifications

Table 1 provides key construction parameters for the No Action Alternative. In RLUOB, NNSA would install equipment in currently unequipped laboratory space and re-equip three laboratory rooms, consistent with the revised limit for a Radiological Facility of up to 38.6 grams PuE. Activities to be conducted at RLUOB under this limit would include AC and some MC capabilities, including radiochemistry, trace-element analysis, mass spectrometry, sample preparation and distribution, assay, AC and MC research and development, and support operations. Modification and refitting of RLUOB is already underway and is scheduled to be completed in approximately 3 to 5 years.

Similar to those described under the Proposed Action Alternative (Section 3.1.1), modifications to RLUOB would require temporary reconfiguration of security and radiological control boundaries. The types of waste generated during modification of RLUOB would be similar to those under the Proposed Action Alternative.

3.2.2 PF-4 Modifications

In PF-4, NNSA would adjust existing laboratory space for AC and MC operations that require quantities of radiological materials greater than those allowed in RLUOB laboratories. Equipment in some laboratory rooms in PF-4 would be removed, and new equipment would be installed or existing equipment would be reconfigured. Modifications would be completed in approximately 7 years, subject to funding.

Modifications to PF-4 would be similar to those described under the Proposed Action Alternative (Section 3.1.2), except that one additional room would be converted to laboratory space for AC and MC operations. Reconfiguration would require removal of some ventilated enclosures, equipment, and materials; reconfiguration of some enclosures; and installation of new enclosures, instrumentation, and ancillary equipment.

3.2.3 Operations

Under the No Action Alternative, RLUOB would be operated as a Radiological Facility with a MAR limit of up to 38.6 grams PuE. AC and MC operations requiring quantities of radioactive materials greater than those allowed in RLUOB laboratories would be conducted in reconfigured space within PF-4. Table 2 summarizes the key operating parameters for the No Action Alternative.

Most of the facility conditions and controls described in Section 3.1.3 apply to both the Proposed Action and the No Action Alternatives. Therefore, only the differences between the alternatives are highlighted in this section.

As shown in Table 2, the No Action Alternative would employ more radiation workers at PF-4 than the Proposed Action Alternative, along with fewer radiation workers at RLUOB. Like the Proposed Action Alternative, most would be existing workers from the CMR Building, RLUOB, and PF-4. Under the No Action Alternative, only about 30 FTEs would be new hires.

As described in Section 3.1.3 for the Proposed Action Alternative, gaseous process emissions from RLUOB and PF-4 would pass through HEPA filters before being released to the atmosphere. Total radionuclide emissions from RLUOB and PF-4 under the No Action Alternative are expected to be similar to those under the Proposed Action Alternative, although a larger portion of the emissions would originate from PF-4 because more AC and MC operations would occur in PF-4 under the No Action Alternative.

As described in Section 3.1.3, radioactive and hazardous wastes would be generated largely from sample preparation and disposal, empty containers and laboratory glassware, spent filters, and personal protective equipment. Because more activities would occur in PF-4 under the No Action Alternative, a larger portion of the waste would originate from that facility.

3.3 Alternatives Considered but Eliminated from Further Analysis

A number of alternatives were considered but not carried forward for further analysis in this EA because either they had already been analyzed or had already been considered and dismissed in previous NEPA documents. After reviewing these alternatives again, NNSA continues to consider them unreasonable, with one exception. For the reasons discussed in Chapter 2, Section 2.1, the Proposed Action Alternative addressed in this EA reflects an alternative that was previously determined to be not feasible, that of using distributed capabilities at LANL for AC and MC operations (see Section 3.3.3). The following alternatives were considered but eliminated from further analysis:

- Extensive Upgrades to the Chemistry and Metallurgy Research Building
- Limited Upgrades to the Chemistry and Metallurgy Research Building
- Distributed Capabilities at Other Existing LANL Nuclear Facilities
- Constructing a Chemistry and Metallurgy Research Building Replacement at LANL
- Constructing Multiple New Buildings at LANL
- Alternative Sites
- Delaying a Decision

The reasons for eliminating these alternatives from further analysis are discussed in the following subsections.

3.3.1 Extensive Upgrades to the Chemistry and Metallurgy Research Building

In the *CMRR EIS* (DOE 2003b), DOE considered the proposal to complete extensive upgrades to the existing CMR Building's structural and safety systems to meet current mission support requirements for another 20 to 30 years of operations and dismissed it from detailed analysis. DOE determined that the extensive upgrades originally planned would be much more expensive and time-consuming and of only marginal effectiveness. As a result, DOE decided to perform only the upgrades necessary to ensure the short-term safe and reliable operation of the CMR Building and to seek an alternative path for long-term reliability. Over the long term, NNSA cannot continue to operate the assigned LANL mission-critical CMR support capabilities in the existing CMR Building at an acceptable level of risk to public and worker health and safety without operational restrictions. These operational restrictions preclude the full implementation of the needed level of operation. Therefore, this alternative was not evaluated further in the *CMRR EIS* and likewise was not analyzed in this EA.

3.3.2 Limited Upgrades to the Chemistry and Metallurgy Research Building

The *CMRR-NF SEIS* (DOE 2011c) described why limited upgrades to the existing CMR Building had been considered and dismissed from further evaluation. NNSA had considered undertaking a more limited, but intensive, set of upgrades to a single wing of the CMR Building, Wing 9, to meet current seismic design requirements so that this wing could be used for a limited set of Hazard Category 2 AC and MC operations. Due to the various engineering and geological issues; the costs of implementing upgrades to an older structure, developing a new security infrastructure, and maintaining a second security infrastructure and safety basis (in addition to that for TA-55); the mission work disruptions associated with construction; operational constraints due to the limited laboratory space; and programmatic and operational issues and risks from moving special nuclear material between TA-3 and TA-55, this alternative was not further evaluated in the *CMRR-NF SEIS* and likewise was not analyzed in this EA.

NNSA also has considered the possibility of renovating, upgrading, and reusing other CMR Building wings and additional wing combinations to provide the space needed for continuing AC and MC work. However, for the reasons cited in the previous paragraphs, the other wings and wing combinations are not considered reasonable alternatives for providing adequate safe and secure space for future operations in a cost-effective manner and therefore were not further evaluated in the *CMRR-NF SEIS* and likewise were not analyzed in this EA.

3.3.3 Distributed Capabilities at Other Existing Los Alamos National Laboratory Nuclear Facilities

In the February 2004 ROD (69 FR 6967) for the *CMRR EIS*, NNSA decided that AC and MC capabilities would be located in TA-55. Locating the AC and MC capabilities in TA-55 reflects NNSA's goal to bring all LANL nuclear facilities into a nuclear core area. Siting of the AC and MC capabilities in TA-55 would place them near the existing PF-4, where the programs that make the most use of these capabilities are located. RLUOB has already been constructed in TA-55. Therefore, only locations in close proximity to TA-55 were considered in this EA.

As a result of the recent increase in the quantity of nuclear material allowed in a Radiological Facility (i.e., up to 38.6 grams PuE), this EA also considered the use of other existing Radiological Facilities at LANL, in combination with RLUOB, to provide the necessary AC and MC capabilities. Two variations of this alternative were considered: (1) operation of RLUOB as a Radiological Facility and (2) operation of RLUOB as a Hazard Category 3 Nuclear Facility, but with less than 400 grams PuE. NNSA's goal to consolidate all LANL plutonium operations at TA-55 effectively limits this alternative to one viable Radiological Facility, the adjacent Target Fabrication Facility (TFF) in TA-35, located immediately east of the TA-55 boundary. Although TFF currently houses some MC capabilities similar to those available in or proposed for RLUOB, the facility was completed in 1983 and therefore was not designed to meet modern seismic requirements. In addition, only a small fraction of the building floor space is configured and suitable for MC operations. Furthermore, operations have been limited to very small quantities of plutonium and other nuclear materials. Even if TFF were to be modified to house additional AC and MC capabilities, it would be limited to up to 38.6 grams PuE. Operating both RLUOB and TFF as Radiological Facilities would provide less than 20 percent of the MAR limit that could be achieved by operating RLUOB as a MAR-limited Hazard Category 3 Nuclear Facility as proposed. It would be neither necessary nor economically feasible to modify the TFF to increase its AC and MC capabilities, given that operating RLUOB as proposed would provide the necessary AC and MC capabilities in one modern facility. For these reasons, this alternative was not further analyzed in this EA.

3.3.4 Constructing a Chemistry and Metallurgy Research Building Replacement Nuclear Facility at Los Alamos National Laboratory

Various configurations for a CMR Building Replacement at LANL were evaluated in the *CMRR EIS* (DOE 2003b) and *CMRR-NF SEIS* (DOE 2011c). In the February 12, 2004, ROD for the *CMRR EIS* (69 FR 6967), DOE selected the Preferred Alternative and decided to construct and operate RLUOB and CMRR-NF. On October 18, 2011, DOE issued an amended ROD (76 FR 64344) for the *CMRR NF-SEIS*, selecting the Modified CMRR-NF Alternative for constructing and operating the CMRR-NF portion of the CMRR project.

In 2012, NNSA took actions in accordance with the President's fiscal year 2013 (FY 2013) budget request, which included no funding for CMRR-NF and deferred construction of the CMRR-NF for at least 5 years (DOE 2012a). Accordingly, DOE began to investigate other less costly methods of providing future AC and MC capabilities. The proposal to relocate AC and MC capabilities to RLUOB and PF-4 is a consequence of these investigations. The CMRR-NF was cancelled in the *Department of Energy FY 2016 Congressional Budget Request*, *National Nuclear Security Administration* (DOE 2015b). Therefore, the CMRR-NF is no longer a reasonable alternative and was not further analyzed in this EA.

3.3.5 Constructing Multiple New Buildings at Los Alamos National Laboratory

The *CMRR-NF SEIS* (DOE 2011c) described why construction and operation of multiple new buildings at LANL had been considered and dismissed from further evaluation. A three-building CMRR Facility (RLUOB and two nuclear facilities), as considered in the *CMRR EIS*, would have separated the nuclear facility functions by hazard categorization, resulting in two buildings (a Hazard Category 2 Nuclear Facility and a Hazard Category 3 Nuclear Facility). A parallel concept to separate the CMRR Facility functions based on their security classification requirements was considered, which would also result in two nuclear facilities.

Dividing the laboratory space between two nuclear facilities rather than using a single nuclear facility does not change the task area space requirements for performing the AC, MC, and research functions. However, dividing laboratory space between facilities would slightly increase the overall task area space needed because some task area space would be duplicated in each building. Although the level of controls would differ, systems and support space (e.g., change rooms, utilities, air-handling and filtration systems, and monitoring and control systems) would be required in each building. Constructing two buildings (and duplicating the systems and support space) would increase the required amounts of construction materials and, if they were constructed in parallel, would require additional land areas for support space. Operating two separate buildings (in addition to RLUOB) would require a slight increase in support personnel (e.g., radiological control technicians) and more operational personnel (e.g., materials and waste packaging and transfer staff). Therefore, multiple new building configuration and construction proposals for AC and MC capabilities were not further evaluated in the *CMRR-NF SEIS* (DOE 2011c) and likewise were not analyzed in this EA.

3.3.6 Alternative Sites

As discussed in the 2011 *CMRR-NF SEIS*, the 2008 *Complex Transformation SPEIS* (DOE 2008b) analyzed other potential locations outside LANL for the required AC and MC operations. In the ROD for the *Complex Transformation SPEIS* (73 FR 77644), NNSA included its decision to retain plutonium manufacturing and research and development at LANL. This decision supports NNSA's goal of consolidating activities and reducing the size of the Nation's nuclear weapons complex, together with modernizing outmoded infrastructure. Therefore, because the alternative sites for key activities within the nuclear weapons complex, as well as the need for the AC and MC capabilities, have been reviewed in depth and programmatic decisions already have been issued, no additional sites outside of LANL were considered in this EA.

3.3.7 Delaying a Decision

NNSA also considered delaying a decision regarding the Proposed Action at this time and re-examining it at a later date, perhaps as long as several decades from now. However, space is needed to support critical AC and MC mission-support work that can no longer be performed in the CMR Building. Therefore, delaying a decision and re-examining it at a later date is not a feasible option, and this alternative was not analyzed in this EA.

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4.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

> To evaluate potential environmental consequences on an annual basis, the analyses in this section depend in part on assumptions about the length of time that activities such as facility modifications take place. If the analyzed activity takes less or more time to complete than that assumed, then the potential annual environmental consequences may be increased or reduced, although the total (collective) consequences would not change.

This section presents the affected environment and potential environmental consequences for the Proposed Action and No Action Alternatives for those environmental resource areas identified as relevant for this EA. The affected environment information for each resource area is provided in summary form; considerable additional information is provided in other NEPA documents such as the *LANL SWEIS* (DOE 2008a) and the *CMRR-NF SEIS* (DOE 2011c).

The analysis uses a sliding-scale approach that is consistent with DOE's *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (DOE 2004b). This guidance implements the CEQ regulations directing agencies preparing EISs to focus on significant environmental issues and alternatives (40 CFR 1502.1) and on impacts in proportion to their significance (40 CFR 1502.2(b)). Less depth and breadth of analysis should be applied to resource areas that clearly have minor environmental impacts, while greater depth and breadth of analysis should be applied to resource areas that have potentially larger impacts. The degree to which the potential environmental consequences for a resource area may be controversial is a factor when determining the appropriate depth and breadth of analysis.

NNSA thus performed a screening analysis to identify resource areas warranting more detailed analyses. **Table 3** presents the results of this screening analysis. More detailed analyses are described in Sections 4.1 through 4.5, respectively, for human health consequences from normal operations, human health consequences from potential accidents, waste management, transportation, and environmental justice. Less detailed analyses are discussed in Sections 4.6 through 4.14 for the land use, geology and soils, water resources, ecological resources, cultural resources, air quality and climate, visual resources and noise, infrastructure, and socioeconomic resource areas.

Table 3. Screening of Resource Areas for More Detailed Analysis

Resource Area	***Detailed Analysis?***	***Section***
Human Health – Normal Operations	Yes	4.1
Human Health – Facility Accidents	Yes	4.2
Waste Management	Yes	4.3
Transportation	Yes	4.4
Environmental Justice	Yes	4.5
Land Use	No	4.6
Geology and Soils	No	4.7
Water Resources	No	4.8
Biological Resources	No	4.9
Cultural Resources	No	4.10
Air Quality and Climate	No	4.11
Visual Resources and Noise	No	4.12
Infrastructure	No	4.13
Socioeconomics	No	4.14

The analysis in this EA focuses on the environmental consequences that could result from activities within or near RLUOB and PF-4 at TA-55. Activities at TA-55 would be supported by operations at other TAs, including the waste management capabilities in TA-54, the TRU Waste Facility in TA-63, and the RLWTF in TA-50. However, the impacts from operations at these facilities have been evaluated in previous NEPA documents (e.g., DOE 2008a, 2015a), and the activities under the alternatives addressed in this EA are not expected to cause additional unevaluated impacts.

4.1 Human Health – Normal Operations

This section addresses radiological impacts on members of the public and LANL workers. Health risks were considered for the offsite population within a 50-mile radius, an average member of the public within this population, a member of the public identified as the maximally exposed individual (MEI), and involved workers.[22] Members of the public and workers are protected from exposure to radioactive material and hazardous chemicals by facility design and administrative procedures. DOE regulations and directives include 10 CFR Part 820, "Procedural Rules for DOE Nuclear Facilities," DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOE 2011a), 10 CFR Part 835, "Occupational Radiation Protection," and 10 CFR Part 851, "Worker Safety and Health Program."

To protect the public from impacts from radiological exposure, DOE Order 458.1 imposes an annual individual dose limit of 10 millirem from airborne pathways (incorporating the requirements of 40 CFR Part 61, Subpart H), 100 millirem from all pathways, and 4 millirem from the drinking-water pathway. Public doses from all pathways must be maintained to levels as low as reasonably achievable (ALARA). To protect workers from impacts from radiological exposure, 10 CFR Part 835 imposes an individual dose limit of 5,000 millirem in a year. However, DOE's goal is to maintain radiological exposures ALARA. Therefore, DOE has recommended that DOE sites establish administrative control levels for individual worker doses based on an evaluation of historical and projected radiation exposures, work load, and mission (DOE 2008c). The administrative control level for LANL is 500 millirem in a year (DOE 2008a).

Radiation Dose and Risk Terms

Roentgen equivalent man (rem) – A unit of radiation dose used to measure the biological effects of different types of radiation on humans. The dose in rem was estimated using a formula that accounts for the type of radiation, the total absorbed dose, and the tissues involved. One thousandth of a rem is a millirem.

Person-rem – A unit of collective radiation dose applied to a population or group of individuals. It is calculated as the sum of the estimated doses, in rem, received by each individual of the specified population. For example, if 1,000 people each received a dose of 1 millirem, the collective dose would be 1 person-rem (1,000 persons × 0.001 rem).

Latent cancer fatalities (LCFs) – Deaths from cancer resulting from, and occurring sometime after, exposure to ionizing radiation or other carcinogens. This environmental assessment focuses on LCFs as the primary means of evaluating health risk from radiation exposure. The values reported for LCFs are the increased risk of a fatal cancer for an individual worker or member of the public, or the increased risk of a single fatal cancer occurring in an identified population comprising workers or members of the public (e.g., the public within a 50-mile radius of a nuclear facility).

[22] An involved worker is an onsite worker who is directly or indirectly involved with operations at a facility and receives an occupational radiation exposure from direct radiation (i.e., neutron, x-ray, beta, or gamma) or from radionuclides released to the environment from normal operations. A noninvolved worker is a site worker outside of a facility who is unlikely to be subjected to direct radiation exposure, but could be exposed to emissions from that facility. The offsite population comprises members of the general public living within 50 miles of a facility. The MEI is a hypothetical member of the public at a location of public access that would result in the highest exposure, which is assumed to be at the site boundary during normal operations and postulated accidents.

4.1.1 Affected Environment

Members of the Public

The major source of radiation exposure to the public is background radiation, which consists of natural background radiation and radiation from man-made sources. Levels of background radiation for the population in the vicinity of LANL are shown in **Table 4**. Radon is the primary source of exposure from natural background radiation, while medical use of radionuclides is the dominant contributor from man-made sources. As shown in Table 4, the total annual dose to an individual in the LANL area from background radiation can be as high as 880 millirem.

Normal releases from LANL operations are an additional source of exposure to the public. Airborne releases of radionuclides from LANL operations are monitored, and radiation doses among members of the public are annually determined. Ingestion doses (including doses from drinking water) are too small to measure and are essentially zero (LANL 2016c).

Table 4. Background Sources of Radiation Exposure That Affect Individuals in the Vicinity of Los Alamos National Laboratory

Radiation Source	*Effective Dose Equivalent (millirem per year)*
Natural Background Radiation	
External cosmic [a]	50 to 90
External terrestrial	50 to 150
Internal terrestrial	30
Radon (in homes)	300
Other Background Radiation	
Diagnostic and nuclear medicine	300
Consumer and industrial products	10
Total	**740 to 880**

[a] Cosmic radiation doses are larger in the higher elevations west of LANL and smaller at the lower elevations near the Rio Grande.

Source: LANL 2017.

Annual population dose data for LANL is provided in **Table 5**. Between 2007 and 2016, the annual dose to the population within a 50-mile radius of LANL ranged from 0.06 (in 2015) to 0.79 person-rem (in 2008) (LANL 2017). For comparison, the same population received a dose from natural background radiation of about 268,000 person-rem in 2016 (LANL 2017, Table 8-1). The population dose from LANL operations in 2016 (0.10 person-rem) to a population of 343,000 translates to an average dose of less than 0.0003 millirem to an individual within a 50-mile radius of LANL (LANL 2017).

As also indicated in Table 5, the dose that the MEI could receive from airborne emissions of radionuclides ranged from a low of 0.12 millirem in 2016 to a high of 3.53 millirem in 2011. Note that the MEI dose of 3.35 millirem in 2011 resulted from the one-time event of remediating Material Disposal Area B; the dose in all other years was no higher than 0.58 millirem. All of the MEI doses in Table 5 are well below the regulatory limits (10 millirem from airborne pathways and 100 millirem from all pathways) of DOE Order 458.1 (DOE 2011a) and much lower than the individual dose from background radiation.

Table 5. Population and MEI Dose from Normal Operations at Los Alamos National Laboratory

Year	*Population Dose (person-rem)* [a]	*MEI Dose (millirem)*
2007	0.36	0.52
2008	0.79	0.55
2009	0.57	0.55
2010	0.22	0.33
2011	0.58	3.53 [b]
2012	0.27	0.58
2013	0.14	0.21
2014	0.28	0.24
2015	0.06	0.13
2016	0.10	0.12

MEI = maximally exposed individual.
[a] Population within 50 miles of LANL; 343,000 in 2016.
[b] The 3.53 millirem dose resulted from the remediation of Material Disposal Area B.
Source: LANL 2017.

No latent cancer fatalities (LCFs) are expected in the affected population. Using a risk estimator of 6.0×10^{-4} LCF per rem or person-rem of exposure (DOE 2003a), the calculated risk of an LCF within the exposed population from annual exposures ranged from about 4×10^{-5} in 2015 to about 5×10^{-4} in 2008. Using the same risk estimator, the estimated probability of the MEI developing an LCF from any of these annual exposures ranged from about 7×10^{-8} (1 chance in about 14 million) in 2016 to about 2×10^{-6} (1 chance in 500,000) in 2011. Using the same risk estimator, the probability of an individual developing an LCF from exposure to 1 year of natural and other background radiation (up to 880 millirem with an average of about 780 millirem [LANL 2017]) would be about 0.0005, or 1 chance in 2,000.

Public health impacts from chemical hazards could occur during normal operations at LANL via inhalation of air containing hazardous chemicals released to the atmosphere by LANL operations. Other potential pathways that pose risks to public health include ingestion of contaminated drinking water or direct exposure. Adverse health impacts on the public from hazardous chemicals are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and achieve compliance with permit requirements. LANL maintains monitoring and inspection programs to verify the effectiveness of these controls (DOE 2011c).

LANL Workers

LANL workers receive the same dose as the general public from background radiation, but they also receive a dose from working in facilities with nuclear materials. **Table 6** presents the average dose to an individual LANL radiation worker and the cumulative dose to all workers from operations in 2012 through 2016. These doses fall within the radiological limits established by 10 CFR Part 835. Using a risk estimator of 6.0×10^{-4} LCFs per rem or person-rem of exposure[23] among workers, the highest individual risk of an individual worker developing an LCF from any of these exposures is 6×10^{-5} (1 chance in about 17,000). No LCFs among the worker population are expected from these annual doses. Based on the total worker dose presented in the table, the calculated risk of an LCF among all

[23] A worker dose to risk conversion factor of 5×10^{-4} may be used (DOE 2003a). The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radio-sensitive infant and child age groups. However, as suggested by this reference document, given uncertainties in the risk estimates, the same value that was used for the general public was used for workers.

LANL workers from normal operations during the 5 years from 2012 through 2016 ranged from about 0.06 to 0.08.

Table 6. Radiation Doses to Los Alamos National Laboratory Workers from Normal Operations in 2012 through 2016 (total effective dose equivalent)

Occupational Personnel	*Radiation Doses Due to Onsite Releases and Direct Radiation*						
	Standard	*2012*	*2013*	*2014*	*2015*	*2016*	*Five-Year Average*
Average radiation worker (millirem)	(a)	97	81	68	86	86	84
Total workers (person-rem) [b]	None	140	139	95	97	96	113

[a] The radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, DOE's goal is to maintain radiological exposure as low as reasonably achievable. Therefore, DOE has recommended that DOE sites implement administrative control levels (DOE 2008c) and make reasonable attempts to maintain individual worker doses below the administrative levels. The administrative control level for LANL is 500 millirem in a year (DOE 2008a).

[b] There were 1,106 workers with measurable doses in 2016; 1,135 in 2015; 1,401 in 2014; 1,703 in 2013; and 1,438 in 2012 (DOE 2015d, 2016c, 2017b).

Chemical exposure pathways to LANL workers during normal operations could include inhaling the workplace atmosphere, drinking LANL potable water, and contacting hazardous materials associated with work assignments. Workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. LANL workers are also protected by adherence to Occupational Safety and Health Administration (OSHA) and U.S. Environmental Protection Agency (EPA) occupational standards for exposure to potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals used in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm (DOE 2011c).

4.1.2 Environmental Consequences of the Proposed Action Alternative

This section presents the potential radiological consequences from facility modifications and AC and MC operations under the Proposed Action Alternative. Individual and population radiological doses and risks were determined for members of the public, workers, and fan offsite MEI. The analysis concentrated on impacts that could occur due to emissions of radioactive material to the air from RLUOB and PF-4 because neither facility modifications nor AC and MC operations would result in a discharge of radioactive material to the subsurface or an uncontrolled release of radioactive material to surface waters. In addition, the use of hazardous chemicals at LANL was evaluated for members of the public and workers.

4.1.2.1 Radiological Impacts during Facility Modifications

Current air emissions from RLUOB do not meaningfully contribute to the public dose from operations at LANL (LANL 2016c). Modifications to RLUOB are not expected to add to radiological air emissions from the facility because the modifications will occur in radiologically clean areas. No public radiation doses are expected from the more extensive modifications to PF-4 that were evaluated in the *2015 CMRR SA* (DOE 2015a). Therefore, the less extensive modifications to PF-4 under the Proposed Action Alternative are not expected to result in public radiation doses.

The radiological impacts to involved workers during modifications to RLUOB and PF-4 were evaluated in the *2015 CMRR SA* and resulted primarily from the removal and replacement of gloveboxes and other enclosures and equipment at PF-4. The *2015 CMRR SA* concluded that RLUOB modifications would not result in any meaningful dose to workers.

The *2015 CMRR SA* (DOE 2015a) indicated that the average individual worker involved in modifications to PF-4 would receive an annual dose of about 300 millirem. The total worker dose from PF-4 modifications under the Proposed Action Alternative were calculated by adjusting the total doses determined for the facility modifications under the No Action Alternative (as derived from the *2015 CMRR SA*) by the ratio of the number of enclosures removed, modified, or installed at PF-4 under both alternatives. (As shown in Table 1, 128 enclosures would be removed, modified, or installed at PF-4 under the No Action Alternative, and 100 enclosures would be removed, modified, or installed at PF-4 under the Proposed Action Alternative.) As shown in **Table 7**, this would result in a total worker population dose of about 200 person-rem. The individual worker annual dose would be well below the DOE worker dose limit of 5,000 millirem (10 CFR Part 835) and less than the administrative control limit at LANL of 500 millirem per year (DOE 2008a). If the same worker were to receive the average annual dose for the entire time required for PF-4 modifications, that worker would receive a dose of 1.7 rem.

No LCFs within the worker population are expected; the calculated number of LCFs from doses received both annually and over the entire facility modification period would be 0.02 and 0.1, respectively. For an individual worker, the risk of an LCF would be 2×10^{-4} (1 chance in 5,000 of an LCF) annually. If that worker received the average annual dose for all the time required for PF-4 modifications, the risk of that worker receiving an LCF would be 1×10^{-3} (1 chance in 1,000 of an LCF).

Table 7. Proposed Action Alternative – Radiological Impacts to Workers Modifying PF-4

Radiation Dose or Risk [a]	*Individual Worker*	*Worker Population*
Annual Dose or Risk from Facility Modifications		
Dose	300 millirem [b]	36 person-rem [c]
Risk (LCF) [d]	2×10^{-4}	0 (0.02)
Dose limit [e]	5,000 millirem	Not applicable
Administrative control limit [f]	500 millirem	Not applicable
Total Dose or Risk from Facility Modifications		
Dose	1.7 rem [b]	200 person-rem
Risk (LCF) [d]	1×10^{-3}	0 (0.1)

LCF = latent cancer fatality; PF-4 = Plutonium Facility, Building 4.

[a] The risk to an individual worker is the risk of an LCF and is a value less than or equal to 1. The risk to the worker population is the projected number of LCFs in the population and is a whole number; the calculated number of LCFs is provided in parentheses.

[b] Estimated dose from *2015 CMRR SA* for workers involved in enclosure and equipment removal, reconfiguration, and replacement activities during modifications to PF-4 (DOE 2015a). The same worker was assumed to be involved in facility modifications for the entire period.

[c] Estimated PF-4 construction worker population from the *2015 CMRR SA* (DOE 2015a).

[d] Based on worker risk estimates of 0.0006 LCFs per rem or person-rem (DOE 2003a).

[e] 10 CFR 835.202.

[f] DOE 2008a.

4.1.2.2 Radiological Impacts during AC and MC Operations

Under the Proposed Action Alternative, radiological emissions from RLUOB and PF-4 are expected to be no more than the quantities listed in **Table 8** (LANL 2018). These emissions are the same as those identified for AC and MC operations in the *CMRR EIS* (DOE 2011c). LANL has indicated that there would be reduced AC and MC operations, resulting in reduced emissions, at RLUOB and PF-4 compared to those from historical use of the CMR Building. For example, LANL has indicated that future AC and MC operations would likely not involve processing krypton or xenon, but samples containing trace levels of these elements could be tested (LANL 2018). Nonetheless, the emissions projected in the *CMRR EIS* and *CMRR SEIS* were conservatively assumed for analysis.

Table 8. Proposed Action Alternative – Radiological Emissions Due to AC and MC Operations

Radionuclide	*Emissions (curies per year)*
Plutonium-239 (equivalent)	0.00076
Krypton-85	100
Xenon-131	45
Xenon-133	1,500
Tritium oxide	750
Tritium (elemental)	250

Source: LANL 2018.

Due to the limitations on material quantities that would be imposed on activities in RLUOB, some AC and MC operations requiring larger quantities of material would be performed at PF-4. The decision on which facility would be used for a test would be made as individual testing needs are identified. Although the majority of the work may be performed at RLUOB, the portion of work to be performed at each facility has not yet been defined. Therefore, it was assumed for analysis that all operational emissions under the Proposed Action Alternative would come from RLUOB. Conversely, for the No Action Alternative, all emissions were assumed to come from PF-4. These two assumptions enable a comparison of the differences in public impacts between the Proposed Action and No Action Alternatives.

Table 9 shows the annual impacts to the population projected to be living within a 50-mile radius of RLUOB in 2030 (a population of approximately 497,000); the impacts to an average member of the public; and the impacts to an offsite MEI located at the LANL site boundary directly north of RLUOB.[24]

As shown in Table 9, the estimated annual population dose associated with RLUOB operations is 0.98 person-rem. The MEI would receive an estimated annual dose of 0.082 millirem, and the average annual dose to an individual within the population would be 0.0020 millirem. DOE has established an annual limit of 10 millirem for a radiation dose received due to releases of radionuclides to the air from all sources at a DOE site (DOE Order 458.1 [DOE 2011a]). The average individual and MEI doses are both less than 1 percent of this limit. Additionally, for comparison, Table 9 presents the population and individual doses from exposure to natural background radiation levels in the Los Alamos area. As shown, the population and individual doses from RLUOB operation are both well below 1 percent of the dose from natural background radiation.

No LCFs are expected among the population within 50 miles of RLUOB because the calculated annual risk of an LCF in the population is much less than 1 (6×10^{-4}). The corresponding increased risk of an average individual within this population developing an LCF is about 1×10^{-9}, or 1 chance in a billion for each year of operation. For the MEI, an increased annual risk of developing an LCF is about 5×10^{-8}, or 1 chance in 20 million for each year of operation.

[24] The 2030 population was projected to be approximately 497,000 within 50 miles of RLUOB and 488,000 within 50 miles of PF-4. The principal reason for the difference in the population estimates is that RLUOB is somewhat closer to Albuquerque than PF-4; thus the 50-mile radius for this facility includes a slightly larger portion of the Albuquerque populated area.

Table 9. Proposed Action Alternative – Annual Radiological Impacts of AC and MC Operations at RLUOB on Members of the Public

Radiation Dose or Risk [a]	*Maximally Exposed Individual*	*Population Within 50 Miles* [b]	*Average Individual Within 50 Miles*
Radiation Dose	0.082 millirem	0.98 person-rem	0.0020 millirem
Risk (LCF)[c]	5×10^{-8}	0 (6×10^{-4})	1×10^{-9}
Regulatory dose limit [d]	10 millirem	Not applicable	10 millirem
Dose as a percentage of the regulatory limit	0.82	Not applicable	0.020
Dose from natural background radiation	570 millirem	220,000 person-rem	430 millirem
Dose as a percentage of background dose	0.01	0.0004	0.0005

AC = analytical chemistry; LCF = latent cancer fatality; MC = materials characterization.

[a] The risk to an MEI or an average individual within 50 miles is the risk of an LCF and is a value less than or equal to 1. The risk to the population within 50 miles is the projected number of LCFs in the population and is a whole number; the calculated number of LCFs is provided in parentheses.

[b] The population dose for this table was based on a projected 2030 population estimate of 497,270 within 50 miles of RLUOB. The population within a 50-mile radius, as determined from U.S. Census data for 2015 (Census 2017a), was projected to 2030 based on the trends in the populations in the counties within the 50-mile radius.

[c] Based on a risk estimator of 0.0006 LCFs per rem or person-rem (DOE 2003a).

[d] DOE Order 458.1 establishes an annual limit of 10 millirem via the air pathway to any member of the public from DOE operations. This limit was derived from the requirements in 40 CFR Part 61, Subpart H.

Until RLUOB and PF-4 begin AC and MC operations, public impacts from operation of the CMR Building would continue. In the *CMRR EIS*, DOE estimated that the projected 2020 population (448,000) within 50 miles of the CMR Building would receive an annual dose of 0.059 person-rem, with an average individual dose of 1.3×10^{-4} millirem. The MEI would receive an annual dose of 0.0059 millirem. No LCFs were expected in the population within 50 miles of the CMR Building (calculated value of 4×10^{-5} LCF), while the annual risks of an LCF to an average individual in this population and the MEI were estimated to be 7.9×10^{-11} and 3.5×10^{-9}, respectively (1 chance in 13 billion and 1 chance in 290 million, respectively) (DOE 2003b).

The radiological impacts to AC and MC workers in the PF-4 and RLUOB facilities were evaluated in the *2015 CMRR SA* (DOE 2015a), which projected an average annual dose of about 10 millirem for workers at RLUOB. Projected worker doses at PF-4 were based on an average dose of 170 millirem to a PF-4 worker prior to the facility modifications. This dose is higher than the worker dose for a CMR worker and higher than the average dose to a LANL worker who received a measurable dose (see Table 6). These average individual doses and an assumed operational workforce of 48 at PF-4 and 135 at RLUOB were used to generate the information presented in **Table 10**. The individual worker annual doses of 170 and 10 millirem at PF-4 and RLUOB, respectively, are well below the DOE worker dose limit of 5,000 millirem (10 CFR Part 835) and less than the LANL administrative control limit of 500 millirem (DOE 2008a). The average dose would result in a worker population dose of 9.5 person-rem per year of operation.

No LCFs are expected among the worker population from this annual dose because the calculated risk is much less than 1 (6×10^{-3}). The average individual risk of an LCF from these annual exposures would be 1×10^{-4} (1 chance in 10,000 of an LCF) and 6×10^{-6} (1 chance in about 170,000 of an LCF), respectively, for a worker at PF-4 and RLUOB.

Table 10. Proposed Action Alternative – Annual Radiological Impacts of AC and MC Operations at RLUOB and PF-4 on Involved Workers

Radiation Dose or Risk [a]	*Individual Worker*	*Worker Population* [b]
PF-4 Dose or Risk		
Dose	170 millirem [c]	8.2 person-rem
Risk (LCF) [d]	1×10^{-4}	0 (5×10^{-3})
RLUOB Dose or Risk		
Dose	10 millirem [c]	1.4 person-rem
Risk (LCF) [d]	5×10^{-5}	0 (8×10^{-4})
Total Dose or Risk		
Dose	Not applicable	9.5 person-rem
Risk (LCF) [d]	Not applicable	0 (6×10^{-3})
Dose limit [e]	5,000 millirem	Not applicable
Administrative control limit [f]	500 millirem	Not applicable

AC = analytical chemistry; LCF = latent cancer fatality; MC = materials characterization; PF-4 = Plutonium Facility, Building 4; RLUOB = Radiological Laboratory/Utility/Office Building.

[a] The risk to an individual worker is the risk of an LCF and is a value less than or equal to 1. The risk to the worker population is the projected number of LCFs in the population and is a whole number; the calculated number of LCFs is provided in parentheses.

[b] Based on an AC and MC worker population of 48 at PF-4 and 135 at RLUOB. Dose and administrative limits do not exist for worker populations.

[c] *2015 CMRR SA* dose for workers at PF-4 and RLUOB (DOE 2015a).

[d] Based on worker risk estimates of 0.0006 LCFs per rem or person-rem (DOE 2003a).

[e] 10 CFR 835.202.

[f] DOE 2008a.

Until all AC and MC operations are established in RLUOB and PF-4, workers performing AC and MC operations at the CMR Building would continue to receive radiation doses at that facility. In the *CMRR SEIS* (DOE 2011c), the annual dose at the CMR Building was estimated to be 21 person-rem, while the average annual individual radiation dose was estimated to be 100 millirem, representing an annual risk of an LCF of 6×10^{-5} (1 chance in about 17,000 of an LCF). Worker doses at the CMR Building would decline as AC and MC operations transfer from the CMR Building to TA-55.

4.1.2.3 Hazardous Chemicals Impacts

Members of the public would not receive chemical-related health impacts from facility modifications and AC and MC operations at PF-4 and RLUOB. As stated in the *2015 CMRR SA* (DOE 2015a), the laboratory quantities of chemicals that could be released to the atmosphere during normal operations would be minor and below the screening levels used to determine the need for additional analysis. Workers would be protected from adverse effects from the use of hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals.

4.1.3 Environmental Consequences of the No Action Alternative

As with the Proposed Action Alternative (see Section 4.1.2), individual and population radiological doses and risks were determined for members of the public and for workers, and radiological doses and risks were determined for an offsite MEI. The analysis again concentrated on impacts that could occur due to emissions of radioactive material to the air from RLUOB and PF-4 because neither facility modifications nor AC and MC operations would result in a discharge of radioactive material to the subsurface (including groundwater) or in an uncontrolled release of radioactive material to surface waters. In addition, the use of hazardous chemicals at LANL was evaluated for members of the public and for workers.

4.1.3.1 Radiological Impacts during Facility Modifications

As under the Proposed Action Alternative, current air emissions from RLUOB do not meaningfully contribute to the public dose from operations at LANL. Modifications to RLUOB are not expected to change the radiological air emissions from the facility because the modifications would occur in radiologically clean areas. No public radiation doses are expected from the modifications to PF-4 that were evaluated in the *2015 CMRR SA* (DOE 2015a). Therefore, modifications to PF-4 under the No Action Alternative are not expected to result in public radiation doses. Radiological impacts to workers for modifications to PF-4 were evaluated in the *2015 CMRR SA* and resulted primarily from the removal and replacement of gloveboxes and other enclosures and equipment at PF-4 (DOE 2015a).

The *2015 CMRR SA* indicated that the total worker dose from modifications to PF-4 would be about 36 person-rem per year, and modifications to RLUOB would not result in any meaningful dose to workers. The average individual dose for a worker involved in PF-4 modifications would be about 300 millirem per year (DOE 2015a). As shown in **Table 11**, the total worker population dose for the entire period of facility modifications would be about 253 person-rem (DOE 2015a). The individual worker annual dose of 300 millirem would be well below the DOE worker dose limit of 5,000 millirem (10 CFR Part 835) and less than the administrative control limit at LANL of 500 millirem (DOE 2008a). If the same worker received the average annual dose for the entire period of facility modifications, that worker would receive a total dose of 2.1 rem.

No LCFs are expected within the worker population because the calculated number of LCFs in the population from doses received annually and over the entire facility modification period is less than 1 (calculated values of 0.02 LCF and 0.2 LCF, respectively). For an individual worker, the risk of an LCF is 2×10^{-4} (1 chance in 5,000 of an LCF) annually; if that worker received the average annual dose for the entire period of facility modifications, the risk of that worker receiving an LCF would be 1×10^{-3} (1 chance in 1,000 of an LCF).

Table 11. No Action Alternative – Radiological Impacts to Involved Workers during PF-4 Modifications

Radiation Dose or Risk [a]	*Individual Worker*	*Worker Population*
Annual Dose or Risk from Facility Modifications		
Dose	300 millirem [b]	36 person-rem [c]
Risk (LCF) [d]	2×10^{-4}	0 (0.02)
Dose limit [e]	5,000 millirem	Not applicable
Administrative control limit [f]	500 millirem	Not applicable
Total Dose or Risk from Facility Modifications		
Dose	2.1 rem [b]	253 person-rem
Risk (LCF) [d]	1×10^{-3}	0 (0.2)

LCF = latent cancer fatality; PF-4 = Plutonium Facility, Building 4.

[a] The risk to an individual worker is the risk of an LCF and is a value less than or equal to 1. The risk to the worker population is the projected number of LCFs in the population and is a whole number; the calculated number of LCFs is provided in parentheses.

[b] Estimated worker dose from *2015 CMRR SA* for workers involved in enclosure and equipment removal, reconfiguration, and replacement activities at PF-4 (DOE 2015a). The same worker was assumed to be involved in facility modifications for the entire period.

[c] Estimated worker population dose for PF-4 modifications from the *2015 CMRR SA* (DOE 2015a).

[d] Based on worker risk estimates of 0.0006 LCFs per person-rem (DOE 2003a).

[e] 10 CFR 835.202.

[f] DOE 2008a.

4.1.3.2 Radiological Impacts during AC and MC Operations

Radiological emissions from RLUOB and PF-4 are not expected to exceed the annual quantities listed in Table 8 under the Proposed Action Alternative. As discussed in Section 4.1.2.2, LANL has indicated that AC and MC operations would be reduced, which would correspondingly reduce RLUOB and PF-4 emissions compared to those from historical use of the CMR Building. Nonetheless, the emissions projected in the *CMRR EIS* (DOE 2003b) and *CMRR SEIS* (DOE 2011c) for AC and MC operations were conservatively assumed for this EA as well as in the *2015 CMRR SA* (DOE 2015a).

Due to the limitations on material quantities that would be imposed on activities in RLUOB, some AC and MC operations requiring larger quantities of material would be performed at PF-4. The decision on which facility would be used for a test would be made as individual testing needs are identified. The portion of work to be performed at each facility has not yet been defined, but under the No Action Alternative, there would be greater restrictions on the quantities of material that could be used at RLUOB than under the Proposed Action Alternative. Therefore, it was assumed that all emissions under the No Action Alternative would come from PF-4. Conversely, for the Proposed Action Alternative, all emissions were assumed to occur from RLUOB. These two assumptions enable a comparison of the differences in public impacts between the No Action and Proposed Action Alternatives.

Potential radiological impacts were estimated for the general public living within 50 miles of PF-4. **Table 12** shows the annual collective impacts to the population projected to be living within a 50-mile radius of PF-4 in 2030 (a population of approximately 488,000; see footnote 24); the impacts to an average member of the public; and the impacts to an offsite MEI who is located at the LANL site boundary directly north of PF-4.

Table 12. No Action Alternative – Annual Radiological Impacts on Members of the Public from AC and MC Operations

Radiation Dose or Risk [a]	*Maximally Exposed Individual*	*Population Within 50 Miles* [b]	*Average Individual Within 50 Miles*
Dose	0.16 millirem	1.2 person-rem	0.0025 millirem
Risk (LCF) [c]	1×10^{-7}	0 (7×10^{-4})	1×10^{-9}
Regulatory dose limit [d]	10 millirem	Not applicable	10 millirem
Dose as a percentage of the regulatory limit	1.7	Not applicable	0.02
Dose from natural background radiation	570 millirem	220,000 person-rem	430 millirem
Dose as a percentage of background dose	0.03	0.0005	0.0006

AC = analytical chemistry; LCF = latent cancer fatality; MC = materials characterization.

[a] The risk to an MEI or to an average individual within 50 miles is the risk of an LCF and is a value less than or equal to 1. The risk to the population within 50 miles is the projected number of LCFs in the population and is a whole number; the calculated number of LCFs is provided in parentheses.

[b] The population dose for this table was based on a projected 2030 population estimate of 488,152 surrounding PF-4. The population within a 50-mile radius, as determined from U.S. Census data for 2015 (Census 2017a), was projected to 2030 based on the trends in the populations in the counties within the 50-mile radius.

[c] Based on a risk estimator of 0.0006 LCFs per rem or person-rem (DOE 2003a).

[d] DOE Order 458.1 establishes an annual limit of 10 millirem via the air pathway to any member of the public from DOE operations. This limit was derived from the requirements in 40 CFR Part 61, Subpart H.

Table 12 shows the annual population dose associated with AC and MC operations to be 1.2 person-rem. The MEI would receive an annual dose of 0.16 millirem, and the annual dose to an average individual in the population would be 0.0025 millirem. DOE has established an annual limit of 10 millirem for a radiation dose received from releases of radionuclides to the air from all sources at a DOE site (DOE Order 458.1 [DOE 2011a]). The MEI dose from PF-4 operations would be less than 2 percent of this limit, while the average individual dose would be well below 1 percent of this limit. Additionally, Table 12 provides for comparison the population and individual doses from exposure to natural background radiation levels for the Los Alamos area. As shown, the population and individual doses from AC and MC operations are both well below 1 percent of the dose from natural background radiation.

No LCFs are expected within the general population because the annual risk of an LCF in the population is much less than 1 (7×10^{-4}). The increased risk of an average individual within 50 miles developing an LCF would be about 1×10^{-9}, or 1 chance in 1 billion per year of operation. For the MEI, there would be an increased annual risk of developing an LCF of about 1×10^{-7}, or 1 chance in 10 million per year of operation.

Until RLUOB and PF-4 begin AC and MC operations, public impacts from operation of the CMR Building would continue, as addressed in Section 4.1.2.2. That is, the projected 2020 population within 50 miles of the CMR Building would receive an annual dose of 0.059 person-rem, with no expected LCFs within this population (calculate value of 4×10^{-5} LCF). The average individual within this population and the MEI would receive doses of 1.3×10^{-4} millirem and 0.0059 millirem, respectively, with risks of an LCF or 7.9×10^{-11} (1 chance in 13 billion) and 3.5×10^{-9} (1 chance in 290 million), respectively.

The radiological impacts to AC and MC workers at PF-4 and RLUOB were evaluated in the *2015 CMRR SA* (DOE 2015a). Projected worker doses at PF-4 were based on the average dose to a PF-4 worker prior to the facility modifications, which is higher than the worker dose for a CMR worker and higher than the average dose to a LANL worker who receives a measurable dose. Based on this average worker dose and the assumed 60-person work force for AC and MC operations in PF-4 and 100 in RLUOB (DOE 2015a), the average and total workforce radiological impacts are presented in **Table 13**. The average worker dose would be 170 millirem per year in PF-4 and 10 millirem per year in RLUOB. These individual worker annual doses would be well below the DOE worker dose limit of 5,000 millirem (10 CFR Part 835) and less than the administrative control limit of 500 millirem at LANL (DOE 2008a). The resulting annual worker population dose would be 11 person-rem.

Table 13. No Action Alternative – Annual Radiological Impacts of AC and MC Operations on Involved Workers

Radiation Dose or Risk [a]	*Individual Worker*	*Worker Population* [b]
PF-4 Dose or Risk		
Dose	170 millirem [c]	10 person-rem
Risk (LCF) [d]	1×10^{-4}	0 (6×10^{-3})
RLUOB Dose or Risk		
Dose	10 millirem [c]	1 person-rem
Risk (LCF) [d]	6×10^{-6}	0 (6×10^{-4})
Total Dose or Risk		
Dose	Not applicable	11
Risk (LCF) [d]	Not applicable	0 (7×10^{-3})
Dose limit [e]	5,000 millirem	Not applicable
Administrative control limit [f]	500 millirem	Not applicable

AC = analytical chemistry; LCF = latent cancer fatality; MC = materials characterization; PF-4 = Plutonium Facility, Building 4; RLUOB = Radiological Laboratory/Utility/Office Building.

[a] The risk to an individual worker is the risk of an LCF and is a value less than or equal to 1. The risk to the worker population is the projected number of LCFs in the population and is a whole number; the calculated number of LCFs is provided in parentheses.

[b] Based on an AC and MC worker population of 60 at PF-4 and 100 at RLUOB (DOE 2015a). Dose limits and administrative limits do not exist for worker populations.

[c] Dose evaluated in the *2015 CMRR SA* for workers at PF-4 and RLUOB (DOE 2015a).

[d] Based on worker risk estimates of 0.0006 LCFs per rem or person-rem (DOE 2003a).

[e] 10 CFR 835.202.

[f] DOE 2008a.

No LCFs from this annual dose are expected among the worker population because the calculated risk of an LCF is much less than 1 (7×10^{-3}). The average individual risks of an LCF from these annual doses are 1×10^{-4} (1 chance in 10,000 of an LCF) and 6×10^{-6} (1 chance in about 170,000 of an LCF), respectively, for a worker at PF-4 and RLUOB.

Until all AC and MC operations are established in RLUOB and PF-4, workers performing AC and MC operations at the CMR Building would continue to receive radiation doses. In the *CMRR SEIS* (DOE 2011c), the annual worker dose at the CMR Building was estimated to be 21 person-rem, and the annual average individual radiation dose was estimated to be 100 millirem, representing an annual risk of an LCF of 6×10^{-5} (1 chance in about 17,000 of an LCF). Worker doses at the CMR Building would decline as AC and MC operations transfer to RLUOB and PF-4.

4.1.3.3 Hazardous Chemicals Impacts

Members of the public would not receive chemical-related health impacts from facility modifications and AC and MC operations at PF-4 and RLUOB. As stated in the *2015 CMRR SA* (DOE 2015a), the laboratory quantities of chemicals that could be released to the atmosphere during normal operations would be minor and below the screening levels used to determine the need for additional analysis. Workers would be protected from adverse effects from the use of hazardous chemicals by adherence to OSHA and EPA occupational standards that limit concentrations of potentially hazardous chemicals.

4.2 Human Health – Facility Accidents

Potential accidents associated with operations at PF-4, RLUOB, and support facilities have been extensively evaluated in existing NEPA documents and safety analyses for those facilities. These NEPA documents include the *CMRR EIS* (DOE 2003b), *LANL SWEIS* (DOE 2008a), *CMRR-NF SEIS* (DOE 2011c), *2015 CMRR SA* (DOE 2015a), and *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement* (*SPD Supplemental EIS*) (DOE/EIS-0283-S2) (DOE 2015c). These facilities maintain safety basis documents that evaluate the hazards associated with operations and identify controls to provide reasonable assurance of adequate protection of workers, the public, and the environment, taking into account the work to be performed and the associated hazards (10 CFR 830.4(c)). In addition, the *LANL Data Call Response* (LANL 2018) reviews the range of potential nuclear and chemical hazards in RLUOB and identified bounding accident scenarios based on the existing safety documents for RLUOB and the CMR Building.

For this EA, the proposed operations at affected facilities were reviewed to determine whether the new operations would result in substantial changes to the accident risks identified in safety basis documents in previous NEPA analyses. The NEPA documents cited above evaluate a range of accidents, including operational accidents such as spills, fires, and explosions; accidents initiated by external events such as wildfires and aircraft crashes; and natural phenomena-initiated events such as earthquakes. The operations associated with the proposed activities at PF-4 and RLUOB are similar to those identified in the current NEPA documents that support those facilities, including the *2015 CMRR SA*, which evaluated the categorization of RLUOB as a Radiological Facility with a limit of 38.6 grams PuE (i.e., the current No Action Alternative); the *LANL SWEIS* and the *SPD Supplemental EIS* for PF-4; the *CMRR EIS;* the *CMRR-NF SEIS* for RLUOB; and the *LANL SWEIS* for support facilities including waste management capabilities in TA-50 and TA-54. The proposed changes evaluated in this EA do not introduce new types of hazards compared to those identified in these existing NEPA documents, and the accident risks are expected to be well within the range of those reported in them. In some cases, the amounts of radionuclides in gloveboxes and rooms would decrease substantially from the quantities assumed in these previous NEPA documents. From an accident risk and impact perspective, the principal difference between the No Action Alternative and the Proposed Action Alternative is the proposal to raise the RLUOB building inventory limit from 38.6 grams PuE to 400 grams PuE. No new accident scenarios were identified during tours of RLUOB, review of existing NEPA documents, or evaluation of the LANL safety reviews of the Proposed Action in RLUOB and the existing safety basis documents for PF-4.

The following subsections identify how the proposed changes in operations at PF-4, RLUOB, and support facilities would affect accident risks in those facilities, and describe the extent to which the accident risks reported in the existing NEPA documents bound the incremental risks associated with the proposed changes in operations. This EA refers to existing analyses in previous NEPA documents and safety analyses, and – particularly for RLUOB – models the impacts from potential accidents using the MACCS2 (MELCOR Accident Consequence Code System) computer code (NRC 1990, 1998). Inputs to the analyses include the source term for each modeled accident, which refers to the quantity of material released to the environment from the accident. The source term is initiated by aerosolization of the material from the accident, which depends on the form of the material, the degree and robustness of the containment, and the energetics of the accident scenario. Once the material is aerosolized, it must travel through building confinement and filtration systems or bypass the systems before there is a possibility of release to the air. No accident scenarios were identified that would result in a substantial release of radioactive material via liquid pathways.

The five-factor formula from DOE-HDBK-3010-95 (DOE 2013b) was used the estimate the airborne source term for each evaluated accident:

$$\text{Source Term} = \text{MAR} \times \text{DR} \times \text{ARF} \times \text{RF} \times \text{LPF}$$

Where:

MAR = material-at-risk (curies or grams)

DR = damage ratio

ARF = airborne release fraction

RF = respirable fraction

LPF = leak path factor

Radioactive doses and risks were evaluated for noninvolved workers, the offsite population, and an MEI. A noninvolved worker is a site worker outside of a facility who would not be subject to direct radiation exposure, but could be exposed to emissions from that facility, particularly during postulated accidents. The offsite population comprises members of the general public living within 50 miles of an affected facility. The MEI is a hypothetical member of the public at a location of public access that would result in the highest exposure, which was assumed to be at the LANL site boundary during postulated accidents. For individuals or population groups, estimates of potential LCFs were made using a risk estimator of 0.0006 LCF per rem or person-rem (DOE 2003a). For acute doses to an individual equal to or greater than 20 rem, the factor was doubled (NCRP 1993).

Appendix A provides details on the above formula factors and other features of the accident analyses.

4.2.1 Potential Accidents at PF-4

Potential severe accidents in PF-4 were evaluated in the *LANL SWEIS* (DOE 2008a) and, more recently, in the *SPD Supplemental EIS* (DOE 2015c). These analyses demonstrate that the PF-4 structure and support equipment provide substantial confinement of radionuclides. The *SPD Supplemental EIS* reflects current operating modes and includes results from TA-55 safety basis documents, including the then current Documented Safety Analysis (DSA).

4.2.1.1 Current/Existing NEPA Accident Analysis for PF-4

The *SPD Supplemental EIS* provides a detailed evaluation of accidents at PF-4, based on accidents evaluated in the PF-4 DSAs. Although many types and isotopic mixtures of plutonium and other radionuclides may be present at PF-4, the PF-4 DSA focuses on weapons-grade plutonium, which is mostly plutonium-239, and heat-source plutonium, which is mostly plutonium-238. For safety analysis purposes, the plutonium inventories for all types and isotopic mixtures are expressed in terms of plutonium-239 equivalent. Thus, for the purposes of this EA, plutonium quantities at PF-4 and in releases from the evaluated accidents are presented as PuE.

Operational accidents included a nuclear criticality (uncontrolled fission reaction), a spill involving 4,500 grams of molten plutonium, a glovebox fire involving 9,000 grams of plutonium, a vault fire involving 1,500 kilograms of plutonium, and a hydrogen deflagration involving 1,040 grams of plutonium in salts and 1,040 grams of plutonium in oxides. In addition, a design-basis earthquake with spills and fires (with degraded confinement) was evaluated, assuming the entire processing (first) floor safety limit of plutonium (2,600 kilograms) was at risk and subject to spillage and fires. In the evaluation of a beyond-design-basis earthquake plus fire, the building ventilation system, the building structure, and the filters were assumed to have failed and to not substantially limit release of material to the environment.

For the *SPD Supplemental EIS* (DOE 2015c), accident source terms were developed that present realistic, yet conservative, estimates of potential releases from PF-4. These accident scenarios were called the SEIS Scenarios in the *SPD Supplemental EIS*. For these SEIS scenarios, the building confinement, including HEPA filters, was expected to continue functioning, although perhaps at a degraded level, during and after the accident.

4.2.1.2 Proposed AC and MC Operations at PF-4

The enhancement of AC and MC operations at PF-4 under both the No Action and Proposed Action Alternatives would replace past PF-4 operations that have been evaluated in PF-4 safety basis documents. Under both alternatives, the proposed AC and MC operations in PF-4 would be similar to those identified in the *CMRR EIS* (DOE 2003b) and *CMRR-NF SEIS* (DOE 2011c), as planned for CMRR-NF. In those EISs, a range of operational accidents was considered, but controls were expected to be in place, including a hardened structure and a robust confinement system that would ensure all operational accidents at CMRR-NF would only release radioactive material to the environment through controlled release via HEPA filters. Similar safety controls are in place at PF-4.

Operational Accidents—For both alternatives, the proposed AC and MC operations could involve operations on samples of nuclear material taken in gram quantities or less from quantities of nuclear material of up to several kilograms (hence the need to conduct operations in a Hazard Category 2 Nuclear Facility instead of RLUOB). The overall inventory of AC and MC materials in PF-4 would likely be less than 10 percent of the PF-4 processing floor inventory, and most of the AC and MC material would be in the form of non-dispersible metal. For AC operations, about 70 percent of the inventory would be metal; for MC operations, more than 95 percent would be metal (DOE 2015a). Potential accidents associated with the proposed AC and MC operations would not have sufficient inherent energy to aerosolize and disperse more material within a glovebox than the bounding operational accidents for PF-4 that were evaluated in the *SPD Supplemental EIS* (DOE 2015c). Those bounding operational accidents could result in airborne plutonium within a PF-4 glovebox from a spill of 4,500 grams of molten plutonium in a glovebox used for the Advanced Recovery and Integrated Extraction System project (SEIS Scenario: 0.028 grams PuE stack release), or a glovebox fire involving 9,000 grams of plutonium (SEIS Scenario: 0.024 grams PuE stack release). The *SPD Supplemental EIS* hydrogen deflagration accident from dissolution of plutonium metal was estimated to result in a stack release of 2.2 grams PuE under the SEIS Scenario (DOE 2015c, Table D-9).

The radiological impacts from bounding operational accidents at PF-4 were estimated in the *SPD Supplemental EIS* to result in doses of up to 0.11 rem to an individual at the site boundary and up to 26 person-rem to the population within 50 miles (with no LCFs expected) (DOE 2015c, Table D-18). The revisions to the PF-4 DSAs between 2011 and 2015 would not change this result. The MAR associated with the proposed AC and MC operations would be lower than that in PF-4 gloveboxes, as evaluated in the *SPD Supplemental EIS*. Thus, the impacts from accidents involving the proposed AC and MC operations in PF-4 would be bounded by the impacts evaluated in the *SPD Supplemental EIS*.

Seismically Initiated Accidents—For both alternatives, the proposed AC and MC operations would not be expected to increase source terms or material releases from PF-4, compared to any of the seismically initiated accidents evaluated for this facility in the *SPD Supplemental EIS*. New AC and MC operations would replace existing activities involving plutonium, as evaluated in current safety basis documents and the *SPD Supplemental EIS* PF-4 accident analysis. The total building plutonium inventory associated with the proposed AC and MC operations would represent a small fraction of current building inventories. For the design-basis earthquake with spill and fire evaluated in the *SPD Supplemental EIS*, the entire processing (first) floor safety limit of plutonium (2,600 kilograms) was considered at risk and subject to spillage and fires. Replacement of some activities evaluated in the *SPD Supplemental EIS* with the AC and MC operations proposed in this EA would not change these material limits. In fact, the MAR associated with the proposed AC and MC operations would be lower than that assumed to be in gloveboxes and PF-4 rooms in the *SPD Supplemental EIS* analysis. The forms of the materials associated with AC and MC operations are not expected to be more vulnerable to large-scale aerosolization in seismic spills and fire accidents than those evaluated in the *SPD Supplemental EIS*. Thus, the impacts from seismically initiated accidents involving the proposed AC and MC operations in PF-4 would be bounded by the impacts evaluated in the *SPD Supplemental EIS*, and the contribution of AC and MC operations to these impacts would be small. For the design-basis earthquake with spill plus fire, the release to the environment was estimated for the SEIS Scenario to be 3.8 to 6.0 grams PuE, depending on the alternative addressed in the *SPD Supplemental EIS* for surplus plutonium disposition (DOE 2015c).

The radiological impacts from the design-basis earthquake with spill plus fire accident were estimated in the *SPD Supplemental EIS* to result in doses of up to 0.19 to 0.30 rem to an individual at the site boundary and up to 71 person-rem to the population within 50 miles (with no LCFs expected) (DOE 2015c, Table D-18). The revisions to the PF-4 DSA between 2011 and 2014 would result in a slight reduction to these doses.

For the beyond-design-basis earthquake with spill plus fire accident, the most recent analysis of potential releases to the environment is in the PF-4 DSA addendum that was addressed in the *SPD Supplemental EIS* (DOE 2015c). That analysis evaluated the potential radiological impacts of an earthquake so severe that it caused major structural damage to the heavily reinforced PF-4. The earthquake was assumed to damage the internal structures, causing the roof to collapse onto the first floor and the first floor to collapse into the basement. It was assumed for analysis that radioactive materials within PF-4 would spill and be impacted by falling structural components, and a major, facility-wide fire would ensue. The assumed extent of damage is highly unlikely, even in an earthquake with ground motion much higher than that of the design-basis earthquake. Although there could be a substantial release of radioactive material following such an earthquake accompanied by a facility-wide fire, loss of life within the facility and within the region due to seismic damage would be the predominant impact of such an earthquake.

The estimated releases to the atmosphere are 321 grams PuE under an *SPD Supplemental EIS* alternative whereby 2 metric tons of plutonium would be processed at PF-4, and 362 grams PuE under an *SPD Supplemental EIS* alternative whereby 35 metric tons of plutonium would be processed at PF-4 (DOE 2015c, Table D-9). Of these releases, materials associated with the Surplus Plutonium Disposition Program would account for approximately 18 percent of the release under the lower throughput case and 32 percent under the higher throughput case.

The radiological impacts from the beyond design-basis earthquake with spill plus fire accident were estimated in the *SPD Supplemental EIS* to result in doses of 16 to 18 rem to an individual at the site boundary and up to 4,300 person-rem in the population within 50 miles (with up to 3 LCFs) (DOE 2015c, Table D-18).

Because the material inventories associated with AC and MC operations are primarily in non-dispersible metal forms, represent less than 10 percent of the overall building inventories, and would not increase the facility MAR, they would not appreciably add to the source term of earthquake-initiated accidents.

Consequently, the potential impacts from the bounding accidents evaluated in the *SPD Supplemental EIS* or current PF-4 safety documents would not be affected by the proposed AC and MC operations.

4.2.2 Potential Accidents in RLUOB

The *LANL Data Call Response* (LANL 2018) reviews the potential nuclear and chemical hazards at RLUOB that are associated with ongoing operations, both as a Radiological Facility (under the No Action Alternative) and as a Hazard Category 3 Nuclear Facility with a 400-gram PuE building inventory limit (under the Proposed Action Alternative).

The chemical inventory and the projected impacts to a collocated worker at 100 meters and a member of the public at 1,000 meters as a fraction of the DOE protective action criteria (PAC) are presented in the *LANL Data Call Response* (LANL 2018). This analysis indicates that no chemical inventory currently exceeds the PAC for either the collocated worker or the public, and the chemical hazard is classified as low. Any revisions to this summary as a result of revisions to the predicted annual facility inventory or presence of new chemicals would be reflected in the Preliminary DSA for RLUOB if the Proposed Action Alternative is selected (LANL 2018). Possible revisions would not exceed PAC levels warranting controls, given the AC and MC operations. Because the chemical hazards to workers were considered standard industrial hazards, and the risks to the public have been shown to be a fraction of PAC-2 level, chemical hazards are not evaluated further in this EA.

The potential nuclear accident scenarios at RLUOB that would be associated with a 400-gram PuE building inventory limit were reviewed for this EA based on past accident evaluations. The AC and MC operations that would take place in RLUOB would be similar to those currently occurring in the CMR Building, Wings 5 and 7, except the MAR limit would be 4,000 grams PuE in each wing. The overall CMR Building limit is even greater (9,000 grams PuE).

The hazards identified for RLUOB operating as a MAR-Limited Hazard Category 3 Nuclear Facility are as follows:

- Fires within the building, a room, or a glovebox
- Explosions due to overpressurizations
- Loss of confinement due to a spill within laboratories or impact during operations
- Direct exposure
- Criticality
- External events (including man-made events), including natural gas explosion, wildland fire, airplane crash, or vehicle impact
- Natural phenomenon, including high wind, earthquake, and lightning strike

The *LANL Data Call Response* identifies a range of controls to prevent or mitigate the postulated accidents, including glovebox or hood; glovebox heat detection; facility ventilation systems; air monitors; fire suppression system; fire detection and paging system; fire barriers; and limits on combustibles. A specific administrative control for the proposed recategorization of RLUOB as a Hazard Category 3 Nuclear Facility is the building MAR limit of 400 grams PuE; this value is used in the analysis of potential impacts in this EA. In addition, a special administrative control of 100 grams PuE as a laboratory room limit would mitigate dose consequences to facility workers in the event of an accident (LANL 2018).

Based on a review of previously prepared NEPA documents and the *LANL Data Call Response* (LANL 2018), the following accidents were selected for evaluation in this EA. These accidents are expected to represent all accidents that might occur in RLUOB with either the 38.6-gram or 400-gram PuE building inventory limit.

Process or Facility-Wide Spill—All of the NEPA documents and safety analyses identify a potential accident whereby a spill results in loss of confinement of the material and release to a room, the building ventilation system (if available), and potentially, the environment. The spill could be initiated by an operator error, equipment failure, impact on the material by equipment, or a severe earthquake. The MAR for this accident could range from a few grams for most glovebox accidents to, in principle, the building inventory limit of 400 grams PuE under the Proposed Action Alternative and 38.6 grams PuE under the No Action Alternative. Because most of the dispersible radioactive materials would be in containers and would not be readily spilled, it was assumed that no more than 10 percent of the building inventory would be in the form of readily dispersible material (i.e., oxide). That is, the damage ratio (DR) was assumed to be 0.1. Because no controls on the form of the material to be analyzed in RLUOB (powder, liquid, or solid) are currently planned, it was assumed that the material would be in the form that is most easily released and results in the greatest radiological impacts. Thus, it was assumed that the spilled material would be powder, with an airborne release fraction (ARF) of 0.002 and a respirable fraction (RF) of 0.3, for a combined ARF×RF of 0.0006. For most spills within RLUOB, the building ventilation and HEPA filtration systems are expected to continue to function, although perhaps at a degraded level. Because a spill would not be expected to threaten the integrity of the building or its HEPA filters, a leak path factor (LPF) of 0.005 was assumed.

Process or Facility-Wide Fire—All of the NEPA and safety documents identify a potential accident whereby a fire results in loss of confinement of the material and release to a room, the building ventilation system (if available), and potentially, the environment. The fire could be initiated by an operator error, equipment failure, impact on the material by equipment, or a severe earthquake. The MAR for this accident could range from a few grams for most glovebox accidents up to, in principle, the building inventory limit of 400 grams PuE under the Proposed Action Alternative and 38.6 grams PuE under the No Action Alternative. Because no controls on the form of the material to be analyzed in RLUOB (powder, liquid, or solid) are currently planned, it was assumed that the material would be in the form that is most easily released and results in the greatest radiological impacts. Release mechanisms include burning or oxidation of plutonium metal, evaporation of heated solutions, and aerosolization of oxides. Because most of the metals and dispersible radiological materials would be in containers and not subject to burning, it was assumed that no more than 10 percent of the building inventory would be in a form subject to rapid oxidation (i.e., burning) or would be readily dispersible (i.e., oxide). Thus, a DR of 0.1 was assumed.

Because the types of operations planned for RLUOB are similar to those historically performed at the CMR Building, most of the inventory will likely be in the form of metal. Because the bounding release mechanism is burning metal, an ARF of 0.0005 and an RF of 0.5 was assumed, for a combined ARF×RF of 0.00025.

For small fires within RLUOB, the building ventilation system is expected to continue to function, although perhaps at a degraded level. The building ventilation system is currently designated as an "item relied upon for safety." Because the postulated fire is not expected to threaten the integrity of the building confinement system or the HEPA filters, an LPF of 0.005 was assumed.

Natural Gas Explosion—The *LANL Data Call Response* identifies a natural gas explosion as a potential accident scenario. A natural gas line is adjacent to RLUOB, and a leak of natural gas into the building and a subsequent explosion could be a mechanism that results in spillage, loss of confinement, and subsequent fires. Controls including adherence to national concensus codes and standards are in place to minimize this type of accident (LANL 2018). For this EA, the radiological impacts from this potential accident are bounded by those from a large earthquake and fire, as addressed below.

Seismic-Induced Spill and Fire—All of the NEPA documents and safety analyses identify a potential accident whereby a major earthquake is the initiator of spills, impacts, and fires that result in loss of confinement of the material and release to a room, the building ventilation system (if available), and potentially, the environment. The MAR for this accident could range from a few grams for most glovebox accidents up to, in principle, the building inventory limit of 400 grams PuE under the Proposed Action Alternative and 38.6 grams PuE under the No Action Alternative. Release mechanisms include spills and impacts to oxides and liquids, burning or oxidation of plutonium metal, evaporation of heated solutions, and aerosolization of oxides due to fires. However, because most of the dispersible radiological materials would be in containers and would not be readily spilled, it was assumed that about 10 percent of the inventory would be in the form of powder that would be subject to dispersal due to seismically initiated spills, impact, blast, and (to a lesser extent) fire (i.e., a DR equal to 0.1). Because no controls on the form of the material to be analyzed in RLUOB (i.e., powder, liquid or solid) are currently planned, it was assumed that the material would be in a form that is most easily released and results in the greatest radiological impacts. It was thus assumed that the material would be in the form of powder, with a combined ARF×RF of 0.0041 due to the combined effects of blast, spill, and impact.

The LPF after a seismic-induced spill and fire is uncertain. The building ventilation system would not be expected to function effectively during and immediately after the event. In the *SPD Supplemental EIS* (DOE 2015c), it was assumed that, for new facilities and significantly upgraded facilities, the ventilation system would be designed not to fail catastrophically (DOE 2015c). Consequently, a building LPF of 0.1 was assumed for this EA and is expected to be conservative and to adequately represent an LPF for cracks in the building or transport through rubble.

Table 14 presents the MAR, building LPFs, and releases for each major accident under the Proposed Action and No Action Alternatives. Accident frequencies presented in Table 14 are estimates based on similar accidents identified in other LANL NEPA documents, as discussed in Appendix A, Section A.1.6.

Table 14. Accident Scenarios and Source Terms for RLUOB

Accident	*Frequency (per year)*[a]	*MAR*	*DR*	*ARF*	*RF*	*LPF*	*Release (g PuE)*
Proposed Action Alternative							
Process or Facility-Wide Spill	1×10^{-2} to 1×10^{-4} (unlikely)	400 g PuE	0.1	0.002	0.3	0.005	1.2×10^{-4}
Process or Facility-Wide Fire	1×10^{-2} to 1×10^{-4} (unlikely)	400 g PuE	0.1	0.0005	0.5	0.005	5.0×10^{-5}
Seismic-Induced Spill and Fire	1×10^{-2} to 1×10^{-4} (unlikely)	400 g PuE	0.1	ARF× RF 0.0041	1	0.1	0.016
No Action Alternative							
Process or Facility-Wide Spill	1×10^{-2} to 1×10^{-4} (unlikely)	38.6 g PuE	0.1	0.002	0.3	0.005	1.2×10^{-5}
Process or Facility-Wide Fire	1×10^{-2} to 1×10^{-4} (unlikely)	38.6 g PuE	0.1	0.0005	0.5	0.005	5.0×10^{-6}
Seismic-Induced Spill and Fire	1×10^{-2} to 1×10^{-4} (unlikely)	38.6 g PuE	0.1	ARF× RF 0.0041	1	0.1	0.0016

ARF = airborne release fraction; DR = damage ratio; g = grams; LPF = leak path factor; MAR = material-at-risk; PuE = plutonium-239 equivalent; RF = respirable fraction.
[a] Accident frequency ranges are discussed in Appendix A, Section A.1.6.

Table 15 presents the impacts to the MEI, to the population within 50 miles of RLUOB, and to a downwind noninvolved worker for the accident scenarios.

Table 15 shows that the risks from the evaluated accidents under the Proposed Action Alternative are about a factor of 10 larger than those under the No Action Alternative. Still, the risks under both alternatives are small. None of the evaluated accidents in either alternative would result in an LCF in the population within 50 miles of RLUOB; similarly, none of the accidents evaluated for either alternative would result in a risk to the MEI or onsite noninvolved worker that would exceed 1. The potential accident with the largest risks is a seismic-induced spill and fire under the Proposed Action Alternative.

For this accident, no LCFs are expected in the population within 50 miles of RLUOB (calculated value: 2×10^{-5} LCF). The risk of an LCF to the MEI would be 2×10^{-8} (1 chance in about 50 million of an LCF), while the risk of an LCF to the onsite noninvolved worker would be 4×10^{-8} (1 chance in 25 million of an LCF).

Table 15. RLUOB Radiological Accident Frequencies and Consequences

Accident	*Accident Frequency (per year)* [b]	*Maximally Exposed Individual* [a]		*Population within 50 Miles*		*Onsite Noninvolved Worker*	
		Dose (rem)	*Increased Probability of LCF* [c]	*Dose (person-rem)*	*Additional LCF* [d]	*Dose (rem)*	*Increased Probability of LCF* [c]
Proposed Action Alternative							
Process or Facility-Wide Spill	1×10^{-2} to 1×10^{-4} (unlikely)	2.3×10^{-6}	1×10^{-9}	2.9×10^{-4}	0 (2×10^{-7})	2.5×10^{-5}	2×10^{-8}
Process or Facility-Wide Fire	1×10^{-2} to 1×10^{-4} (unlikely)	8.9×10^{-8}	5×10^{-11}	7.6×10^{-5}	0 (5×10^{-8})	1.9×10^{-7}	1×10^{-10}
Seismic-Induced Spill and Fire	1×10^{-2} to 1×10^{-4} (unlikely)	2.9×10^{-5}	2×10^{-8}	0.025	0 (2×10^{-5})	6.3×10^{-5}	4×10^{-8}
No Action Alternative							
Process or Facility-Wide Spill	1×10^{-2} to 1×10^{-4} (unlikely)	2.2×10^{-7}	1×10^{-10}	2.8×10^{-5}	0 (2×10^{-8})	2.4×10^{-6}	1×10^{-9}
Process or Facility-Wide Fire	1×10^{-2} to 1×10^{-4} (unlikely)	8.6×10^{-9}	5×10^{-12}	7.4×10^{-6}	0 (4×10^{-9})	1.9×10^{-8}	1×10^{-11}
Seismic-Induced Spill and Fire	1×10^{-2} to 1×10^{-4} (unlikely)	2.8×10^{-6}	2×10^{-9}	0.0024	0 (1×10^{-6})	6.1×10^{-6}	4×10^{-9}

LCF = latent cancer fatality.

[a] The MEI was assumed to be 1.3 kilometers from the accident location.

[b] Accident frequency ranges are discussed in Appendix A, Section A.1.6.

[c] Increased risk of an LCF to an individual, assuming the accident occurs.

[d] The reported value is the projected number of LCFs in the population, assuming the accident occurs, and is therefore presented as a whole number. The result calculated by multiplying the collective population dose by the risk factor (0.0006 LCFs per rem or person-rem per DOE 2003a) is shown in parentheses.

4.2.3 Combined Accident Implications

With implementation of either the Proposed Action or the No Action Alternative, the accident risks associated with nuclear operations in TA-55 would change, but those changes would be small, as discussed below. Such accident risks include those for PF-4, RLUOB, and support operations, including radioactive waste management activities in TA-54. In addition, the accident risks associated with ongoing AC and MC operations in the CMR Building and transfer of nuclear material between the CMR Building in TA-3 and the TA-55 facilities would be eliminated. Overall, NNSA expects that moving AC and MC operations from the CMR Building to modern or upgraded facilities in TA-55 would lower the accident risks associated with AC and MC operations.

The increment to accident risks in the TA-55 area would be small. Bounding operational accidents at PF-4, assuming existing operations, are projected to release 0.024 to 2.2 grams PuE to the environment (DOE 2015c, Table D-9). Replacement of activities in PF-4 rooms and gloveboxes with the AC and MC operations evaluated in this EA would not result in larger potential releases from these bounding operational accidents. The bounding operational accidents (i.e., process or facility-wide spill or fire) in RLUOB under the Proposed Action Alternative would release 5.0×10^{-5} to 1.2×10^{-4} gram PuE to the environment. The bounding operational release from RLUOB (1.2×10^{-4} gram) would represent 0.005 to 0.5 percent of the bounding operational accident releases from PF-4. More realistically, under both the

Proposed Action and No Action Alternatives, many of the RLUOB safety controls, including building ventilation systems, would likely continue to function during most operational accidents.

Assuming a very severe seismic event were to occur that caused wide-scale spills and fires within PF-4, with or without the proposed AC and MC operations, releases of 3.8 to 6.0 grams PuE were estimated in the *SPD Supplemental EIS* (DOE 2015c) for the design-basis earthquake with spill plus fire, while releases of 321 to 362 grams PuE were estimated for the beyond-design basis earthquake with spill plus fire. The bounding seismic release from RLUOB with the proposed AC and MC operations would be 0.016 and 0.0016 grams PuE under the Proposed Action and No Action Alternatives, respectively. Thus, with the addition of AC and MC operations to PF-4 and RLUOB, the combined accident releases and corresponding impacts would be 0.3 to 0.4 percent larger under the Proposed Action Alternative than those from PF-4 alone, assuming a design-basis earthquake, and 0.03 to 0.04 percent larger than those from PF-4 alone under the No Action Alternative. Assuming a beyond design-basis earthquake, combined accident releases would be almost entirely attributable to releases from PF-4. The differences are primarily due to the *SPD Supplemental EIS* assumption that the building ventilation system in PF-4 would continue to function during a design-basis earthquake, with an LPF of 0.005 for plutonium.

Under the Proposed Action and No Action Alternatives, the accident risks associated with continued AC and MC operations at the CMR Building would be eliminated; these risks were evaluated in the *CMRR EIS* (DOE 2003b) and *CMRR-NF SEIS* (DOE 2011c).

Radioactive waste from the room and enclosure changes in PF-4 and the new AC and MC operations in PF-4 and RLUOB would not introduce new types of hazards to waste management activities in TA-54. Similar types of TRU waste (including legacy TRU waste), LLW, and MLLW from the CMR Building, PF-4, and other LANL activities have been routinely handled in TA-54. Waste volumes associated with upgrades to PF-4 and RLUOB and AC and MC operations would be small relative to historic waste volumes, as shown in Section 4.3. These additional waste volumes would not be expected to substantially change accident probabilities. Therefore, the radioactive waste associated with the proposed TA-55 facility modifications and new AC and MC operations would not substantially change the overall radioactive waste accident risks at TA-54.

4.3 Waste Management

4.3.1 Affected Environment

As summarized in the text box, LANL generates a variety of wastes, including TRU and mixed TRU wastes;[25] LLW and MLLW; chemical waste; nonhazardous waste, including routine office trash (sanitary solid waste); and wastewaters (i.e., sanitary liquid waste and industrial effluent). Wastes at LANL are managed in accordance with Federal and state requirements applicable to specific waste types and their content. Operations are conducted in accordance with LANL's waste minimization and pollution prevention program. See the *LANL SWEIS* (DOE 2008a) for additional information.

[25] The analysis of TRU waste management in this section includes mixed TRU waste. All TRU waste generated under the EA alternatives would be contact-handled TRU waste.

Environmental Assessment Definitions of Common Types of Waste at LANL

Transuranic (TRU) waste—Waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes with half-lives greater than 20 years per gram of waste.

Low-level radioactive waste (LLW)—Waste that is radioactive and does not fall into any of the following classifications: high-level radioactive waste, transuranic waste, spent nuclear material, or byproduct materials (uranium and thorium mill tailings).

Mixed low-level radioactive waste (MLLW)—Waste that contains both LLW and hazardous waste, as defined by the Resource Conservation and Recovery Act (RCRA). Management programs for MLLW at LANL include wastes that contain LLW and chemical constituents regulated under other statutes such as the New Mexico Solid Waste Regulations and the Toxic Substances Control Act.

Chemical waste—Chemical waste is not a formal LANL waste category, but per the *LANL SWEIS (DOE 2008a),* denotes a broad category of materials including hazardous waste regulated under RCRA, toxic waste regulated under the Toxic Substances Control Act, and special waste designated under the New Mexico Solid Waste Regulations.

Nonhazardous waste—Waste that is not radioactive or hazardous and can be disposed of in a permitted solid waste landfill.

Wastewater—Any water that has been adversely affected in quality by anthropogenic influence.

Table 16 lists annual quantities of solid radioactive and chemical wastes at LANL, PF-4, other facilities in TA-55, and the CMR Building, in comparison with quantities projected for LANL and these facilities in the *LANL SWEIS* (DOE 2008a). Quantities are listed for 2010 through 2014 (5 years), as reported in recent *LANL SWEIS* yearbooks (LANL 2012, 2013a, 2013b, 2015, 2016b). In addition, Table 16 lists the quantities of nonradioactive wastes that were recycled and disposed of during these years. Within this time frame, RLUOB generated only negligible quantities of radioactive and nonradioactive wastes. During all 5 years, the total quantities of all radioactive and chemical wastes annually generated at LANL were smaller than the projections in the *LANL SWEIS*, and between 44 and 84 percent of all nonhazardous waste was recycled rather than disposed. Generation of radioactive and chemical wastes at TA-55 (primarily PF-4) and the CMR Building was generally less than the annual projections in the *LANL SWEIS*. Exceptions were generation of MLLW at TA-55 during 1 year, generation of chemical waste at TA-55 during 4 years, and generation of TRU waste at the CMR Building during 1 year.

Solid Radioactive Wastes—TA-54 has historically been the location of most LANL solid radioactive and chemical waste management capabilities. TRU waste storage capabilities in TA-54 include below-grade storage in shafts and above-grade storage in domes and on pads.[26] Treatment capabilities include sorting, segregation, and size reduction; waste characterization capabilities include real-time radiography and high-efficiency neutron counting. After characterization, TRU waste was transferred to the Radioassay and Nondestructive Testing Facility (RANT), also located in TA-54, and loaded into TRUPACT packaging for shipment to WIPP (DOE 2015a).

[26] Over the past decade, LANL made considerable progress in reducing the amount of TRU waste stored at TA-54 through processing operations and shipment to WIPP. As of 2014, about 32,950 cubic feet of TRU waste remained in above-grade storage at TA-54, and 84,650 cubic feet remained in below-grade storage, a factor of 50 reduction from the 6,750,000 cubic feet in storage as of 2003 (DOE 2015a).

Table 16. Annual Los Alamos National Laboratory Waste Generation versus *LANL SWEIS* Projections

Waste Volume or Mass	*Waste*	*Year*				
		2010	*2011*	*2012*	*2013*	*2014*
All LANL						
Projected Volume (ft^3)	TRU [a]	170,000	61,300	61,300	91,000	118,000
Actual Volume (ft^3)		4,060	6,330	4,480	3,310	3,070
Percent of Projected Volume		2.4	10	7.3	3.6	2.6
Projected Volume (ft^3)	LLW	5,729,000	3,866,000	3,731,000	3,759,000	3,758,000
Actual Volume (ft^3)		946,000	1,267,000	131,000	103,000	120,000
Percent of Projected Volume		17	33	3.5	2.7	3.2
Projected Volume (ft^3)	MLLW	1,381,000	498,000	498,000	423,000	423,000
Actual Volume (ft^3)		4,020	3,290	1,440	34,000	16,600
Percent of Projected Volume		0.29	0.66	0.29	8.1	3.9
Projected Quantity (pounds)	Chemical	19,619,000	9,422,000	7,752,000	8,140,000	8,479,000
Actual Quantity (pounds)		8,327,000	3,942,000	3,279,000	3,437,000	1,479,000
Percent of Projected Quantity		42	42	42	42	17
Recycled Quantity (tons)	Non-hazardous	3,110	8,520	9,090	7,600	3,740
Landfilled Quantity (tons)		1,850	10,800	2,070	1,420	1,840
Percent Recycled		63	44	81	84	67
TA-55 (Primarily PF-4)						
Projected Volume (ft^3)	TRU [a]	11,900	11,900	11,900	11,900	11,900
Actual Volume (ft^3)		3,530	4,560	2,650	2,830	2,790
Percent of Projected Volume		30	38	22	24	24
Projected Volume (ft^3)	LLW	26,700	26,700	26,700	26,700	26,700
Actual Volume (ft^3)		5,750	6,550	9,460	4,870	8,690
Percent of Projected Volume		22	25	35	18	33
Projected Volume (ft^3)	MLLW	530	530	530	530	530
Actual Volume (ft^3)		755	385	78	106	35
Percent of Projected Volume		140	73	15	20	6.7
Projected Quantity (pounds)	Chemical	19,000	19,000	19,000	19,000	19,000
Actual Quantity (pounds)		26,100	32,400	16,200	339,000 [b]	24,400
Percent of Projected Quantity		140	170	85	1,800 [b]	130
CMR Building						
Projected Volume (ft^3)	TRU [a]	1,480	1,480	1,480	1,480	1,480
Actual volume (ft^3)		110	118	1,520	295	141
Percent of Projected Volume		7.4	7.9	103	20	10
Projected Volume (ft^3)	LLW	64,800	64,800	64,800	64,800	64,800
Actual Volume (ft^3)		22,400	15,700	3,020	1,900	106
Percent of Projected Volume		35	24	4.7	2.9	0.16
Projected Volume (ft^3)	MLLW	671	671	671	671	671
Actual Volume (ft^3)		23	159	1.4	316	106
Percent of Projected Volume		3.4	24	0.21	47	16
Projected Quantity (pounds)	Chemical	24,000	24,000	24,000	24,000	24,000

Waste Volume or Mass	Waste	Year				
		2010	**2011**	**2012**	**2013**	**2014**
Actual Quantity (pounds)		13,600	2,100	2,320	1,530	209
Percent of Projected Quantity		57	8.8	10	6.4	0.87

CMR = Chemistry and Metallurgy; ft^3 = cubic feet; *LANL SWEIS = Final Site-Wide Environmental Impact Statement for Continued Operation of Low Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2008a); LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; PF-4 = Plutonium Facility, Building 4; TA = Technical Area; TRU = transuranic.

[a] Includes mixed TRU waste.

[b] About 97 percent of the total chemical waste generated at TA-55 during this single year resulted from equipment failure and associated cleanup of spilled diesel oil (LANL 2015).

Note: Waste quantities were converted from reported units and rounded to 3 significant figures or to the nearest thousand.

Source: LANL 2012, 2013a, 2013b, 2015, 2016b.

Waste management capabilities in TA-54 are in transition. For many years LANL conducted LLW disposal operations in Area G in TA-54, but these disposal operations were discontinued within a 63-acre area in TA-54. LLW disposal operations elsewhere in Area G are paused. Capabilities exist in Area L of TA-54 for LLW, MLLW, and chemical waste storage, as well as staging for offsite shipment.

Waste management capabilities in TA-55 and other LANL locations have been upgraded. TRU waste characterization capabilities have been installed at TA-55, including nondestructive analysis, flammable gas testing, visual examination equipment, and real-time radiography. Fully characterized TRU waste certified as compliant with the WIPP waste acceptance criteria (DOE 2016a) is loaded into TRUPACT packaging for shipment to WIPP. TRUPACT loading operations may occur at TA-55, the Transuranic Waste Facility in TA-63, or RANT (LANL 2018).

TRU waste storage capabilities in TA-55 were increased from 400 55-gallon drum equivalents to 1,200. As of November 2016, about 56 percent of the volume capacity had been used, as well as about 68.5 percent of the capacity based on MAR limits (LANL 2018). The Transuranic Waste Facility in TA-63[27] is capable of storing 825 55-gallon drum equivalents during normal operations and 1,240 drum equivalents during surge events (DOE 2015c).

Other radioactive wastes generated at TA-55 will be managed using capabilities in TA-55 and TA-54. Staging of LLW for shipment off site for disposal may occur at TA-55 or in Area L of TA-54. Temporary storage of mixed LLW will occur, as required, at TA-55 or at a permitted location in Area L pending shipment off site for treatment or disposal (LANL 2018).

Chemical Waste—Chemical waste including solvents, unused chemicals, laboratory trash, and other materials may be temporarily stored at TA-55 or in Area L at TA-54 pending shipment offsite for treatment and/or disposal (DOE 2015c; LANL 2018).

Solid Nonhazardous Waste—Solid nonhazardous waste is generally transferred to the onsite Los Alamos County Eco Station before shipment to permitted recycle or disposal facilities, such as those in Rio Rancho and Valencia County (DOE 2015c).

[27] DOE decided to transition the waste management capabilities at LANL (73 FR 55833), including construction of the new TRU Waste Facility in TA-63, based on the analysis in the *LANL SWEIS* (DOE 2008a). Becoming operational in 2017, the TRU Waste Facility in TA-63 handles Defense Program newly generated solid TRU waste. (Newly generated solid TRU waste is waste generated after 1999.) The facility is a Hazard Category 2 Nuclear Facility, with a RCRA permit to store hazardous waste. It provides TRU waste storage capacity and includes a RCRA-permitted pad to house characterization and testing trailers used to certify the compliance of containers of TRU waste with the WIPP waste acceptance criteria. The facility also provides intra-site shipping, receiving, and operational support (DOE 2016d).

Wastewater—The RLWTF in TA-50 is the principal LANL facility for treating liquid radioactive waste. It consists of a treatment facility, support buildings, and liquid and chemical storage tanks and receives liquid waste for treatment from various sites across LANL, with permitted outfall to Mortandad Canyon. The tank farm was upgraded in recent years, and new ultrafiltration, reverse osmosis, and nitrate reduction equipment was installed (DOE 2015c). Construction of a replacement for the RLWTF LLW treatment system is ongoing. This new system will include an evaporation unit to eliminate liquid discharges into the environment (DOE 2011c). Additional information about the upgrade project for RLWTF, which includes a facility for storage and treatment of liquid TRU waste, is provided in Chapter 5, Section 5.1.

Sanitary wastewater from LANL facilities is transferred to the Sanitary Wastewater Systems Plant in TA-46, which has an annual capacity of 220 million gallons of liquid sanitary waste. Treated water may be recycled at the TA-3 power plant (as makeup water for cooling towers) or discharged into Sandia Canyon via a permitted outfall. Industrial effluent is discharged through National Pollutant Discharge Elimination System -permitted outfalls. The number of outfalls and annual effluent volumes has been reduced in recent years, with a goal of achieving zero liquid discharge (DOE 2015c).

4.3.2 Environmental Consequences of the Proposed Action Alternative

4.3.2.1 Waste from Facility Modifications

Waste from facility modifications would include radioactive wastes, chemical waste, and nonhazardous waste, such as general trash. **Table 17** summarizes the projected types and quantities of radioactive wastes from facility modifications. Additional information about radioactive and nonradioactive waste generation is provided below.

Table 17. Total Waste Generation from Facility Modifications (cubic feet)

Waste Type	*Proposed Action Alternative*		*No Action Alternative*	
	PF-4	*RLUOB*	*PF-4*	*RLUOB*
TRU waste [a]	3,030 [b]	0	3,520	0
LLW	4,660	105	6,050	105
MLLW	3,460	0	5,440	0

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; PF-4 = Plutonium Facility, Building 4; RLUOB = Radiological Laboratory/Utility/Office Building; TRU = transuranic.

[a] Includes mixed TRU waste. All TRU waste is contact-handled TRU waste.

[b] This volume reflects the envelope volume of large pieces of equipment, including enclosures that would be safely stored after removal from PF-4 pending further processing; these processing operations would likely result in smaller overall TRU waste volumes and larger LLW volumes.

Source: DOE 2015a; LANL 2018.

PF-4 Modifications—Waste from PF-4 modifications would primarily arise from removal or modification of ventilated enclosures and associated piping and equipment. Radioactive wastes, including TRU waste, LLW, and MLLW, would be segregated and placed into containers such as drums or boxes. Workers would dismantle and discard internal glovebox equipment that will not be reused in PF-4. Large pieces of equipment may be secured inside the enclosures rather than removed. The containerized enclosures would generally be temporarily stored, pending processing at TA-54, to minimize the total quantity of TRU waste being generated; radioactive waste from the processing operations would be managed as TRU waste, LLW, or MLLW. Waste characterization may occur at TA-55 or TA-54. Only contact-handled TRU waste is expected.

After processing and characterization, the approximately 3,030 cubic feet of TRU waste from PF-4 modifications may be stored pending shipment to WIPP (see Section 4.3.1). The approximately 4,660 cubic feet of LLW (including, for example, enclosures or waste from enclosure reconfiguration) would be shipped to an offsite disposal facility. MLLW may include materials such as lead-soldered wire, copper tubing joints, or enclosures containing lead shielding. The approximately 3,460 cubic feet of MLLW would be temporarily staged as needed before shipment off site for treatment or disposal.

PF-4 modifications and equipment installation could generate a negligible quantity of chemical waste due to contingency activities such as remediation of chemical spills. If generated, this waste may be temporarily stored, in accordance with regulatory permits, before shipment off site for treatment or disposal. In addition, a small quantity of nonhazardous waste could be generated, such as wooden crates and boxes, metal pipe sections, wire, scrap drywall, or similar materials. This waste would be sorted for disposition by recycle or disposal.

Liquid sanitary waste would be generated in quantities somewhat larger than current rates. Sanitary waste collected in trailered facilities would be shipped off site for treatment. Sanitary waste generated at PF-4 would be routed to the Sanitary Waste System for treatment and discharge to permitted outfalls. Assuming generation of 50 gallons of sanitary waste per person per day and 260 working days per year (DOE 2003b), about 6.2 million gallons of sanitary waste would be generated during the peak year of facility modifications at both PF-4 and RLUOB.

RLUOB Modifications—Modifications to RLUOB would not generate TRU waste; however, about 105 cubic feet of LLW could be generated when making final connections (hot tie-ins) to existing laboratory connections and liquid radioactive waste drain lines and would consist of metal scrap, personal protective equipment, and similar material. LLW would be placed into containers, such as 55-gallon drums or B-25 boxes, and staged for offsite shipment. Minimal MLLW is expected.

Similar to PF-4 modifications, modifications to RLUOB could generate a small quantity of chemical waste due to contingency activities such as remediation of chemical spills. If generated, this waste may be temporarily stored in accordance with regulatory permits before shipment off site for treatment or disposal. A small quantity of nonhazardous waste could be generated, such as wooden crates and boxes, metal pipe sections, wire, scrap drywall, or similar materials. Similar to PF-4 modifications, this waste would be sorted for disposition by recycle or disposal. Sanitary wastes would be addressed as discussed for PF-4 modifications using existing capabilities in RLUOB or trailered facilities.

4.3.2.2 Operational Waste

The *CMRR EIS* (DOE 2003b), *LANL SWEIS* (DOE 2008a), and *CMRR-NF SEIS* (DOE 2011c) estimated the following annual waste volumes from operations under the CMRR project:

- TRU and mixed TRU waste: 2,370 cubic feet
- LLW: 71,280 cubic feet
- MLLW: 700 cubic feet
- Hazardous waste: 24,700 pounds

Due to the reduced scope of operations evaluated in this EA (e.g., no large-vessel cleanout activities), operational waste generation at RLUOB and PF-4 would be smaller than that projected in these NEPA documents.

Small annual quantities of nonhazardous waste would also be generated, to be managed in the same manner as that for PF-4 and RLUOB modifications (Section 4.3.2.1).

The annual quantity of sanitary waste attributable to AC and MC operations would be smaller than that projected in the NEPA documents cited above because fewer operational personnel would be required. Assuming up to 30 additional workers at PF-4 and RLUOB to conduct AC and MC operations (see Section 4.14), 50 gallons of waste generated per worker per day and 260 working days per year (DOE 2003b), about 390,000 gallons would be annually generated.

4.3.2.3 Waste Disposition

Table 18 summarizes annual radioactive and chemical waste quantities from facility modifications and AC and MC operations (Sections 4.3.2.1 and 4.3.2.2) and compares these quantities to projections in the *LANL SWEIS* and actual LANL waste generation rates for the years 2010 through 2014 (see Table 16). The duration of waste generation at PF-4 and RLUOB is uncertain due to a variety of factors, such as funding and scheduling for enclosure removal, modification, and installation. Over the entire duration of facility modifications, there may be periods when little or no waste would be generated at either or both facilities. Based on the number of enclosures to be removed, modified, or installed at PF-4 under the alternatives (see Table 1) and the estimated period for PF-4 modifications from the *2015 CMRR SA* (DOE 2015a) (7 years), for purposes of analyzing the potential impacts on the waste management system, it was assumed that the bulk of radioactive waste from PF-4 modifications would be generated over a 5.5-year period under the Proposed Action Alternative and 7 years under the No Action Alternative. Only a small amount of LLW would be generated at RLUOB from making final connections to existing laboratory connections and liquid radioactive waste drain lines; it was assumed that this waste would be generated over a 1-year period. The table presents the waste annually generated at both PF-4 and RLUOB, assuming waste generation overlaps at the two facilities. Disposition of the wastes addressed in this EA was evaluated by comparison to this table and additional information below.

TRU Waste—TRU waste from PF-4 modifications (3,030 cubic feet) would be generated at an average annual rate of about 550 cubic feet. As shown in Table 18, this volume would represent about 0.32 to 0.90 percent of the total LANL TRU waste volumes projected over the years 2010 through 2014 in the *LANL SWEIS* (DOE 2008a), and about 8.7 to 18 percent of the actual TRU waste generation rate at LANL during these years. The projected annual TRU waste volume from PF-4 modifications would also be smaller than the annual TRU waste volumes projected and that actually generated in the Plutonium Complex alone (see Table 16). Furthermore, the total projected volume of TRU waste (3,030 cubic feet) would represent 33 percent of the volume of TRU waste (9,180 cubic feet) projected from implementation of the TA-55 Reinvestment Project, as evaluated in the *LANL SWEIS*.

TRU waste from PF-4 modifications would be safely stored, pending further processing and characterization (as required) and loading within TRUPACT packaging for delivery to WIPP. TRU waste from PF-4 modifications would not be generated without the assurance of adequate and safe TRU waste management capacity.

The 3,030 cubic feet of TRU waste projected from PF-4 modifications would use a small percentage of the WIPP disposal capacity. The total WIPP capacity for TRU waste disposal is set at 6.2 million cubic feet, pursuant to the Waste Isolation Pilot Plant Land Withdrawal Act. Based on agreements between DOE and the State of New Mexico, this volume includes 5.95 million cubic feet of contact-handled TRU (CH-TRU) waste (DOE 2015a). From DOE's *Annual Transuranic Waste Report – 2016* (DOE 2016b), approximately 586,000 cubic feet of WIPP unsubscribed CH-TRU waste capacity[28] could support the LANL activities evaluated in this EA.[29] The 3,030 cubic feet of TRU waste from the evaluated activities (all CH-TRU waste) would represent only about 0.4 percent of this unsubscribed capacity. In any event, the projected volume is bounded by the TRU waste volume projected from implementation of the TA-55 Reinvestment Project evaluated in the *LANL SWEIS* (DOE 2008a), which is included in the volumes anticipated for WIPP disposal in DOE's *Annual Transuranic Waste Report – 2016*.

[28] The term "unsubscribed" refers to that portion of the total WIPP capacity that is not being used or needed for the disposal of DOE's currently estimated inventory of TRU waste.

[29] The total volume of CH-TRU waste projected for emplacement in WIPP (including anticipated volumes plus volumes already emplaced or in temporary storage) as of the end of 2015 is about 5,364,000 cubic feet (DOE 2016b). Subtracting this volume from the WIPP CH-TRU capacity of 5.95 million cubic feet leaves about 586,000 cubic feet of unsubscribed CH-TRU waste capacity. TRU waste volumes include mixed TRU waste.

Table 18. Comparisons of Annual Radioactive and Chemical Waste Generation Rates from the EA Alternatives to *LANL SWEIS* Projections and Actual Rates

		Proposed Action Alternative			*No Action Alternative*		
Waste Type	*Disposition Method*	*Annual Quantity*	*Percent of LANL SWEIS Projection*	*Percent of Annual LANL Generation Rate*	*Annual Quantity*	*Percent of LANL SWEIS Projection*	*Percent of Annual LANL Generation Rate*
Facility Modifications							
TRU Waste	Offsite disposal at WIPP	550 ft^3	0.32 – 0.90	8.7 – 18	500 ft^3	0.30 – 0.82	7.9 – 16
LLW	Offsite NNSS or commercial disposal	950 ft^3	0.017 – 0.026	0.075 – 0.92	970 ft^3	0.017 – 0.026	0.076 – 0.94
MLLW	Offsite NNSS or commercial disposal	630 ft^3	0.045 – 0.15	1.8 – 44	780 ft^3	0.056 – 0.18	2.3 – 54
Chemical Waste	Offsite commercial disposal	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Operations							
TRU Waste	Offsite disposal at WIPP	2,370 ft^3	1.4 – 3.9	37 – 77	2,370 ft^3	1.4 – 3.9	37 – 77
LLW	Offsite NNSS or commercial disposal	71,280 ft^3	1.2 – 1.9	5.6 – 69	71,280 ft^3	1.2 – 1.9	5.6 – 69
MLLW	Offsite NNSS or commercial disposal	700 ft^3	0.051 – 0.17	2.1 – 49	700 ft^3	0.051 – 0.17	2.1 – 49
Chemical Waste	Offsite commercial disposal	24,700 pounds	0.13 – 0.32	0.30 – 1.7	24,700 pounds	0.13 – 0.32	0.30 – 1.7

ft^3 = cubic feet; *LANL SWEIS = Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2008a); LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NNSS = Nevada National Security Site; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

Note: Under the Proposed Action Alternative, wastes from PF-4 and RLUOB modifications were assumed for analysis to be generated over 5.5 years and 1 year, respectively; under the No Action Alternative, wastes from PF-4 and RLUOB modifications were assumed for analysis to be generated over 7 years and 1 year, respectively. Waste generation from PF-4 and RLUOB modifications was assumed to occur concurrently.

Source: DOE 2015a*;* LANL 2012, 2013a, 2013b, 2015, 2016b.

Operational TRU waste from AC and MC operations would be less than the generation rate projected in the *CMRR EIS* (DOE 2003b) and other NEPA documents (DOE 2008a, 2011c), which was 2,370 cubic feet per year. This TRU waste generation rate would represent about 1.4 to 3.9 percent of the total LANL TRU waste generation rate projected in the *LANL SWEIS*, and 37 to 77 percent of that actually generated from 2010 through 2014 (see Table 18). The operational waste generation rate would be smaller than the annual TRU waste volumes projected and actually generated in the Plutonium Complex alone (see Table 16). Although annual TRU waste generation would increase at TA-55, TRU waste generation would decrease at the CMR Building when AC and MC operations end. From 2010 to 2014, annual TRU and mixed TRU waste generation at the CMR Building ranged from 110 to 1,520 cubic feet (see Table 16). The annual TRU waste volume from AC and MC operations is included in the volumes anticipated by LANL for WIPP disposal in DOE's Annual Transuranic Waste Reports.

TRU waste from AC and MC activities would be stored until it is sent off site for disposal. Because DOE expects that WIPP will be available for TRU waste disposal by the time appreciable quantities of TRU waste from these activities would be generated, NNSA expects that storage requirements would be temporary and storage capacity would be adequate. TRU waste from AC and MC operations would not be generated without the assurance of adequate and safe TRU waste management capacity.

LLW—A total of 4,760 cubic feet of LLW is projected from PF-4 and RLUOB modifications, representing about 14 percent of the 34,830 cubic feet of LLW projected from the TA-55 Reinvestment Project, as evaluated in the *LANL SWEIS*. LLW from PF-4 and RLUOB modifications would be generated at rate of up to 950 cubic feet per year. This small annual volume of LLW would represent about 0.017 to 0.026 percent of the LANL LLW generation rate projected in the *LANL SWEIS* and 0.075 to 0.92 percent of the actual LANL LLW generation rate from 2010 through 2014 (see Table 18).

Although it is possible that some of this LLW could be disposed of on site, it was assumed for analysis that all LLW would be disposed of in offsite facilities. **Table 19** summarizes the percentages of available disposal capacities that the LLW volume would represent at three potential offsite facilities: Energy*Solutions* in Utah, the Nevada National Security Site (NNSS), and Waste Control Specialists (WCS) in Texas. The LLW volume from facility modifications would represent only small percentages of the available disposal capacity at any facility.

Table 19. Percent of Disposal Capacities in the Evaluated Disposal Facilities from Disposal of LLW and MLLW from Facility Modification Activities

Waste Type	*Waste Volume (cubic feet)* [a]	*Percent of Disposal Capacity*		
		EnergySolutions [b]	*NNSS* [c]	*WCS* [d]
Proposed Action Alternative				
LLW	4,760	0.0042	0.010	0.018
MLLW	3,460	0.036	0.086	0.013
No Action Alternative				
LLW	6,150	0.0055	0.013	0.024
MLLW	5,440	0.056	0.14	0.021

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NNSS = Nevada National Security Site; WCS = Waste Control Specialists.

[a] Source: DOE 2015a; LANL 2018.

[b] The disposal capacity for LLW and MLLW was assumed to be the remaining capacity in the Class A West Embankment (113 million cubic feet) and the Mixed Waste disposal cell (9.67 million cubic feet), respectively, as of August 27, 2015 (Energy*Solutions* 2016).

[c] The disposal capacity for LLW and MLLW at the Area 5 Radioactive Waste Management Complex was assumed to be 48 million cubic feet and 4 million cubic feet, respectively, in accordance with DOE's December 30, 2014, ROD (79 FR 78421) for the *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (DOE 2013a).

[d] It was assumed that all LLW and MLLW would be disposed of in the Federal Waste Facility at WCS, which has a total capacity of 26 million cubic feet (736,000 cubic meters) (WCS 2017).

During operations, the annual volume of LLW would be less than that estimated in the *CMRR EIS* (DOE 2003b) and subsequent NEPA documents (DOE 2008a, 2011c), which is annually 71,280 cubic feet. This generation rate would represent about 1.2 to 1.9 percent of that projected from all LANL activities in the *LANL SWEIS* (DOE 2008a) and about 5.6 to 69 percent of the actual LANL generation rate from 2010 through 2014 (see Table 18). Annual LLW generation would increase at TA-55, but decrease at the CMR Building as AC and MC operations end. From 2010 to 2014, annual LLW generation at the CMR Building ranged from about 106 to 22,400 cubic feet (see Table 16). It was assumed that operational LLW would be sent to an offsite disposal facility, such as those listed in Table 19, with no impacts on offsite disposal capacity.

MLLW—About 3,460 cubic feet of MLLW is projected from PF-4 modifications, representing about 59 percent of the 5,830 cubic feet of MLLW projected from the TA-55 Reinvestment Project, as evaluated in the *LANL SWEIS*. MLLW from PF-4 modifications would be generated at an average annual rate of about 630 cubic feet. This annual quantity of waste would represent about 0.045 to 0.15 percent of the LANL MLLW generation rate projected in the *LANL SWEIS* and 1.8 to 44 percent of the actual LANL MLLW generation rate from 2010 through 2014 (see Table 18).

Annual generation of MLLW from AC and MC operations would be less than the 700 cubic feet projected in the *CMRR EIS* (DOE 2003b) and subsequent NEPA documents (DOE 2008a, 2011c). This MLLW generation rate would represent about 0.051 to 0.17 percent of the MLLW that was annually projected in the *LANL SWEIS* and 2.1 to 49 percent of the MLLW that was actually generated at LANL from 2010 through 2014 (see Table 18). Annual MLLW generation would increase at TA-55 as a result of the proposed AC and MC operations, but decrease at the CMR Building as AC and MC operations end. From 2010 to 2014, annual MLLW generation at the CMR Building ranged from about 1.4 to 316 cubic feet (see Table 16).

MLLW may be temporarily stored on site in compliance with permitted storage requirements. Because MLLW storage would occur only until sufficient accumulation of waste to warrant efficient offsite shipment, generation of MLLW due to the activities evaluated in this EA would not impact onsite MLLW storage capacity. All MLLW would be sent off site for treatment or disposal at NNSS or commercial facilities (such as the facilities identified in Table 19), consistent with their waste acceptance criteria. The small MLLW volumes would not impact offsite treatment and disposal capacities.

Chemical Waste—Meaningful quantities of chemical waste are not expected from facility modification activities. In contrast, 2,000 pounds of chemical waste were projected from implementation of the TA-55 Reinvestment Project, as evaluated in the *LANL SWEIS* (DOE 2008a). Annual generation of chemical waste during AC and MC operations would be less than the 24,700 pounds projected in the *CMRR EIS* (DOE 2003b) and subsequent NEPA documents (DOE 2008a, 2011c). This generation rate would represent about 0.13 to 0.32 percent of the chemical waste generation rate projected in the *LANL SWEIS* and about 0.30 to 1.7 percent of the chemical waste actually generated at LANL from 2010 through 2014 (see Table 18). Annual chemical waste generation resulting from the proposed AC and MC operations would increase at TA-55, but decrease at the CMR Building as AC and MC operations end. From 2010 to 2014, annual chemical waste generation at the CMR Building ranged from about 209 to 13,600 pounds (see Table 16).

Chemical waste may be temporarily stored on site in compliance with permitted storage requirements before being sent off site for treatment or disposal. Because waste storage would generally occur only until accumulation of a sufficient quantity of waste to warrant efficient offsite shipment, LANL onsite storage capacity would not be negatively impacted. Because numerous offsite facilities are available for treatment or disposal of the variety of wastes managed as chemical waste at LANL, the waste generated from the activities evaluated in this EA would not impact offsite facility capacities.

Other Wastes—AC and MC operations at PF-4 and RLUOB would annually generate small quantities of liquid LLW to be routed to the RLWTF for treatment. No impacts on the RLWTF annual treatment capacity of 1.1 million gallons are expected.

Facility modifications and operations would generate nonhazardous waste. Consistent with LANL procedures, much of this material would be recycled. During 2010 through 2014, for example, from 44 to 84 percent of all nonhazardous waste generated at LANL was recycled (see Table 16). Facility modifications and operations would also generate liquid sanitary waste. As addressed in Sections 4.3.2.1 and 4.3.2.2, about 6.2 million gallons of sanitary waste would be generated during the peak year of facility modifications, while 390,000 gallons would be annually generated during AC and MC operations. These annual generation rates would represent only about 3 percent and 0.1 percent, respectively, of the Sanitary Waste System annual treatment capacity of 220 million gallons.

4.3.3 Environmental Consequences of the No Action Alternative

4.3.3.1 Waste from Facility Modifications

The same types of facility modifications would occur as those under the Proposed Action Alternative, except that fewer modifications would occur at PF-4, and additional modifications would occur at RLUOB. Therefore, the same types of radioactive and nonradioactive wastes would be generated, except in different quantities. Table 17 summarizes the projected types and quantities of radioactive wastes from facility modifications.

PF-4 Modifications—TRU waste, LLW, and MLLW would be generated and managed using the same methods as those under the Proposed Action Alternative (see Section 4.3.2.1), except in somewhat larger total quantities, as summarized in Table 17. As under the Proposed Action Alternative, TRU waste would be safely stored pending shipment to WIPP for disposal, while LLW and MLLW would be shipped to offsite facilities for treatment or disposal. Any chemical waste generated during facility modifications would be shipped off site for treatment or disposal; nonhazardous waste would be sorted for disposition by recycle or disposal; and liquid sanitary waste would be addressed using existing or modified building capabilities or portable services.

RLUOB Modifications—TRU waste would not be generated. LLW would be generated and managed in the same way as that summarized in Section 4.3.2.1 under the Proposed Action Alternative, except in somewhat larger total quantities. As under the Proposed Action Alternative, this LLW could be generated when making final connections to existing liquid radioactive waste drain lines. No TRU waste or MLLW would be generated.

Somewhat larger quantities of chemical and nonhazardous wastes could be generated during RLUOB modifications due to the increased scope of work at that building compared to that for the Proposed Action Alternative. Sanitary and general trash would be addressed using existing capabilities in RLUOB or trailered sanitary facilities.

4.3.3.2 Operational Waste

Annual waste generation from AC and MC operations would be essentially the same as that under the Proposed Action Alternative (see Section 4.3.2.2).

4.3.3.3 Waste Disposition

As indicated in Table 18, the annual generation rates of TRU waste, LLW, MLLW, and chemical waste under the No Action Alternative would be comparable to those under the Proposed Action Alternative. The annual waste generation rates during facility modification activities and during AC and MC operations would be smaller than those for the entire LANL site that were projected for the years 2010 through 2014 in the *LANL SWEIS* (DOE 2008a) and were actually generated during these years. As under the Proposed Action Alternative, the total generation rates of TRU waste, LLW, and MLLW during facility modification activities at RLUOB and PF-4 would be smaller than those projected for the TA-55 Reinvestment Project evaluated in the *LANL SWEIS*.

NNSA expects that TRU waste storage capacity will be adequate at LANL until TRU waste can be shipped to WIPP for disposal. All TRU waste generated during facility modifications would be CH-TRU waste, which would represent about 0.5 percent of WIPP's unsubscribed CH-TRU capacity (see Section 4.3.2.3). The annual TRU waste volume from AC and MC operations is included in the volumes anticipated by LANL for WIPP disposal in DOE's Annual Transuranic Waste Reports (see Section 4.3.2.3). LLW and MLLW from facility modifications and operations would be shipped off site to Federal or commercial facilities, with no expected impacts on disposal capacity at any of the evaluated offsite facilities (see Table 19).

Chemical waste may be temporarily stored on site, in compliance with permitted storage requirements, before being sent off site for treatment or disposal. Because waste storage would generally occur only until a sufficient quantity of waste is accumulated to allow efficient offsite shipment, LANL onsite storage capacity would not be negatively impacted. Numerous offsite facilities are available for treatment or disposal of the materials managed as chemical waste at LANL, and there would be no impacts on offsite facility capacities.

Liquid LLW, nonhazardous waste, and liquid sanitary waste would be managed in the same manner as that under the Proposed Action Alternative, with no impacts on onsite or offsite waste management capacities.

4.4 Transportation

This section summarizes the potential impacts associated with shipping radioactive waste by truck to offsite treatment or disposal facilities (i.e., DOE/NNSA or commercial sites). All waste transportation and traffic control plans are reviewed by the LANL Traffic Systems Engineer to ensure compliance with the *Manual on Uniform Traffic Control Devices and American Association of State Highway and Transportation* requirements.[30]

Human health impacts could result from transporting radioactive waste during incident-free transport and potential accident conditions. For incident-free transport, the potential human health impacts from the radiation fields surrounding packages containing radioactive material were evaluated for affected transport crews (workers) and populations (members of the public along the route [off-traffic or off-link], sharing the route [in-traffic or on-link], and at rest areas and stops along the route). Impacts were determined as the collective radiation doses received by the affected transport crews and populations, and as risks in terms of the number of LCFs expected among the affected transport crews and populations. Calculated LCFs less than 1 (unity) indicate that no LCFs are expected among the affected transport crews or populations. In addition, incident-free impacts (radiation doses and risks) were evaluated for a hypothetical member of the public assumed to reside alongside the route used for the radioactive shipments.

The analyses for potential accident conditions were performed in three ways. First, analyses were performed that express the impacts of radiological accidents in terms of probabilistic risk (dose-risk), which is defined as the accident probability (accident frequency) multiplied by the accident consequence. These analyses of accident risks account for a spectrum of accidents, ranging from high-probability accidents of low severity (fender benders) to hypothetical high-severity accidents that have corresponding low probabilities of occurrence. Only as a result of a severe fire or a powerful collision, both extremely low-probability events, could a transportation package of the types used to transport radioactive material be damaged to the extent that radioactivity could be released to the environment with significant consequences.

Second, analyses were performed that assessed the nonradiological risks to members of the public that could result from transporting radioactive waste. These nonradiological risks are independent of the nature of the cargo being transported and are expressed as fatal traffic accidents resulting only from the physical forces that accidents can impart to humans. These risks were estimated as the product of the total distance traveled by the transport vehicle and the statistical risk of an accident fatality per unit distance. The risks were determined as the calculated number of traffic fatalities among the populations along the transport routes; calculated risks less than 1 indicate that no traffic fatalities are expected among the affected populations.

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[30] Potential environmental consequences due to shipment to or from LANL of radioactive material that may be subject to AC or MC analysis at LANL are addressed in the *LANL SWEIS* (DOE 2008a).

Third, analyses were performed that assessed the largest radiological consequences from a maximum reasonably foreseeable accident with a radioactive frequency greater than 1×10^{-7} (1 chance in 10 million) per year along the route. These analyses address the question: "what would be the consequences if a severe accident actually occurred?" The analyses were performed using the RISKIND computer program (Yuan et al. 1995), assuming average atmospheric conditions. Radiological consequences were determined in terms of doses and LCF risks to the affected population and to an individual assumed to be located nearby the accident.

No specific offsite transportation risks were evaluated in the *CMRR EIS* (DOE 2003b). The *LANL SWEIS* (DOE 2008a), however, includes a detailed analysis of the impacts from transporting TRU waste to WIPP, LLW to NNSS or a commercial facility in Utah (Energy*Solutions*), and MLLW in the form of evaporator bottoms to treatment facilities in Oak Ridge, Tennessee, with return of the treated MLLW to LANL. The analysis was performed using the population data from the year 2000 census and the RADTRAN 5 computer program (Neuhauser and Kanipe 2003) to estimate the impacts to transport workers, populations, and an MEI who may be a worker or a member of the public (e.g., a person stuck in traffic, a gas station attendee, or an inspector).

For this EA, the transportation risks associated with the projected wastes were evaluated by assuming types and forms of wastes similar to those evaluated in the *LANL SWEIS* (DOE 2008a), projecting the populations along the transport routes to 2030 levels, and using the RADTRAN 6.02 (Weiner et al. 2013) computer program. The RADTRAN 6.02 computer program uses more-recent inhalation dose conversion factors from Federal Guidance Report (FGR) Number 13 (EPA 1999a). In addition, the transportation risks were determined by considering an updated projection of accident risks that used information from the University of Michigan Transportation Research Institute (UMTRI 2003).

For purposes of analysis, environmental consequences were evaluated for transport of TRU waste to WIPP; transport of LLW to Energy*Solutions* in Utah, NNSS, or WCS in Texas; and transport of MLLW to these same three facilities. That is, all three facilities evaluated for disposal of LLW were also evaluated for disposal of MLLW. Energy*Solutions* and WCS both possess extensive capabilities to treat MLLW before disposal in compliance with Federal requirements under the Resource Conservation and Recovery Act (RCRA). Treatment operations for the MLLW generated under the EA alternatives are expected to primarily involve encapsulation of lead contaminated with radioactive material. NNSS has less extensive MLLW treatment capabilities and is only treating MLLW generated within the State of Nevada; treatment of MLLW generated outside the State of Nevada was evaluated, however, in the *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada* (DOE/EIS-0426) (DOE 2013a).

Risks from shipment of nonradioactive wastes to offsite treatment, recycle, or disposal facilities, or transport of nonradioactive materials to LANL (e.g., equipment), would occur only from the physical forces that accidents could impart to humans. These accident risks would be no greater than the risks associated with transport of nonradioactive materials to and from LANL during normal operations.

4.4.1 Environmental Consequences of the Proposed Action Alternative

4.4.1.1 Facility Modifications

Modifications to TA-55 facilities would generate one-time volumes of TRU waste, LLW, and MLLW that would be similar to those evaluated in the *LANL SWEIS*, Appendix G, Section G.7, under the TA-55 Reinvestment Project, which entailed removal and replacement of outdated and degraded gloveboxes and equipment, ventilation ductwork, and other materials. **Table 20** compares the projected number of shipments of radioactive waste under both alternatives. As indicated, the numbers of shipments under both alternatives would be both small and comparable. The projected shipments are far less than the numbers evaluated in the *LANL SWEIS* for operation of LANL over 10 years. Over all alternatives evaluated in the *LANL SWEIS*, the minimum numbers of shipments were 1,460 shipments of TRU waste, 9,217 shipments of containerized LLW, and 196 shipments of MLLW (DOE 2008a).

Table 20. Number of Radioactive Waste Shipments

Waste Type	*Proposed Action Alternative*	*No Action Alternative*
TRU waste	13	15
LLW	12	15
MLLW	8	12

LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; TRU = transuranic.

Table 21 summarizes the potential environmental consequences of shipping radioactive waste by truck to offsite facilities. The consequences were evaluated, assuming all TRU waste would be transported using TRUPACT packaging to WIPP and all LLW and MLLW would be transported in boxes to three optional LLW and MLLW disposal facilities: Energy*Solutions* in Utah, NNSS, and WCS in Texas. (Boxes reflect the primary expected packaging mode for LLW and MLLW from facility modifications.) The table summarizes the environmental consequences for transport of LLW or MLLW only to NNSS because the environmental consequences that were determined for transport of LLW or MLLW to NNSS envelope the consequences for transport to Energy*Solutions* or WCS, or for transport to a combination of the three evaluated facilities. Table 21 also shows the potential environmental consequences from the combination of shipments that would result in the maximum consequences. That is, it was assumed that all TRU waste would be transported to WIPP, and all LLW and MLLW would be transported to the evaluated disposal facility (NNSS), resulting in the largest potential environmental consequences.

Table 21. Potential Environmental Consequences from Transport of Radioactive Waste from Facility Modifications

		Incident-Free Transport				*Accident Conditions*	
Waste	*Destination*	*Crew Dose (person-rem)*	*Crew Risk (LCF)* [a]	*Population Dose (person-rem)* [b]	*Population Risk (LCF)* [a,b]	*Radiological Risk (LCF)* [a,b]	*Nonradiological Risk (traffic fatalities)*
Proposed Action Alternative							
TRU	WIPP	0.30	2×10^{-4}	0. 095	6×10^{-5}	2×10^{-8}	2.9×10^{-4}
LLW	NNSS [c]	0.15	9×10^{-5}	0.048	3×10^{-5}	6×10^{-9}	4.7×10^{-4}
MLLW	NNSS [c]	0.10	6×10^{-5}	0.032	2×10^{-5}	4×10^{-9}	3.1×10^{-4}
All waste [c]	Combination with maximum consequences [d]	0.54	3×10^{-4}	0.17	1×10^{-4}	3×10^{-8}	1.1×10^{-3}
No Action Alternative							
TRU	WIPP	0.34	2×10^{-4}	0.11	7×10^{-5}	2×10^{-8}	3.4×10^{-4}
LLW	NNSS [c]	0.19	1×10^{-4}	0.060	4×10^{-5}	8×10^{-9}	5.9×10^{-4}
MLLW	NNSS [c]	0.15	9×10^{-5}	0.048	3×10^{-5}	6×10^{-9}	4.7×10^{-4}
All waste [c]	Combination with maximum consequences [d]	0.68	4×10^{-4}	0.22	1×10^{-4}	3×10^{-8}	1.4×10^{-3}

LCF = latent cancer fatality; LLW = low-level radioactive waste; MLLW = mixed low-level radioactive waste; NNSS = Nevada National Security Site; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

[a] Determined using a risk of 0.0006 LCF per rem or person-rem (DOE 2003a).

[b] Population radiation doses and risks along the transport routes were evaluated by assuming a population growth to 2030.

[c] The largest environmental consequences are for transport of LLW or MLLW to NNSS. Transport of LLW or MLLW to Energy*Solutions* in Utah or Waste Control Specialists in Texas would result in smaller environmental consequences.

[d] Consequences were determined by summing the doses and risks from transporting all TRU waste to WIPP and the doses and risks from transporting all LLW and MLLW to NNSS. As noted in table note c, transport to NNSS would result in the largest consequences.

Incident-Free Transport—Table 21 shows that the largest potential consequences are those for incident-free transport of TRU waste to WIPP. Even so, because the calculated transport crew and population risks for incident-free transport are both less than 1 (2×10^{-4} LCF and 6×10^{-5} LCF, respectively), no LCFs are expected among the transport crew or the population along the transport route.

Similar to the analysis for TRU waste transport, Table 21 shows that incident-free transport of all LLW or all MLLW is not expected to result in LCFs among the transport crews or populations along the evaluated transport routes because all calculated risks are less than 1. The largest potential consequences among the three evaluated facilities are for transport of LLW or MLLW to NNSS, resulting in a calculated risk to the transport crew of 9×10^{-5} or 6×10^{-5} LCF, respectively, and a calculated risk to the population along the transport route of 3×10^{-5} or 2×10^{-5} LCF, respectively.

Table 21 also shows that incident-free transport of all radioactive waste to the evaluated disposal facilities is not expected to result in an LCF among the transport crews or the populations along the transport routes because all calculated risks are less than 1. Transport of all radioactive waste results in a calculated risk to the transport crews of 3×10^{-4} LCF and a calculated risk to the populations along the transport routes of 1×10^{-4}.

Note that DOE regulations limit the maximum annual dose to a transport crew member to 100 millirem in a year unless the individual is a trained radiation worker. The dose to a trained radiation worker is limited to 5 rem in a year (DOE 2008c). Assuming a risk factor of 0.0006 LCF per rem or person-rem (DOE 2003a), a trained radiation worker receiving a dose at the maximum annual exposure level (5 rem) would have a potential annual LCF risk of 0.003, which is equivalent to a risk of 1 chance in about 330 of an LCF.

A member of the public could reside along the route traveled by trucks transporting radioactive waste to offsite disposal facilities. Assuming an individual receptor was located 98 feet from the truck route (DOE 2008a, K-14) for all shipments, the total dose that this receptor would receive from all shipments of TRU waste, LLW, and MLLW would be about 0.0042 millirem. This dose could result in a total risk of an LCF of about 3×10^{-9} (1 chance in about 330 million of an LCF).

Accident Conditions—Considering all potential accidents from a spectrum of accidents ranging from high-probability accidents of low severity (fender benders) to hypothetical high-severity accidents that have corresponding low probabilities of occurrence, no LCFs are expected among the populations along the transport routes. The largest calculated risk is associated with transport of TRU waste; still, the calculated risk is less than 1 (2×10^{-8} LCF). The calculated risk to the population from a fatal traffic accident from transporting all TRU waste to WIPP is larger than the calculated radiological risk from the spectrum of potential accidents. Nonetheless, no traffic fatalities (calculated risk of 2.9×10^{-4}) are expected. Calculated risks are smaller for shipments of LLW and MLLW. Assuming all shipments of LLW and MLLW were to the facility (NNSS) with the largest transport risks, no LCFs or traffic fatalities are expected among the affected population. The calculated radiological risk for LLW transport is 6×10^{-9}, while the calculated traffic fatality risk is 4.7×10^{-4}. The calculated radiological risk for MLLW transport is 4×10^{-9}, while the calculated traffic fatality risk is 3.1×10^{-4}.

Transport of all radioactive waste is not expected to result in any LCFs among the affected populations or result in a traffic fatality. The calculated radiological risk is 3×10^{-8} LCF, and the calculated traffic fatality risk is 1.1×10^{-3}.

For radioactive waste transported under the Proposed Action Alternative, the maximum reasonably foreseeable offsite truck transportation accident with the greatest consequence would involve a truck carrying TRU waste. The annual probability that such an accident would occur depends on the number of shipments that could occur in a single year. If it is conservatively assumed that all 13 shipments of TRU waste from facility modifications occurred in a single year, then the probability that such an accident could occur is about 2.8×10^{-7} (1 chance in about 3.6 million) per year in a suburban area. If such an accident did occur, the consequences in terms of general population dose would be about 8 person-rem. Such an exposure would result in no LCFs (calculated risk of 5×10^{-3}) among the exposed population. This accident would result in a dose of 8.2 millirem to a hypothetical MEI located 330 feet from the accident and exposed to the accident plume for 2 hours, with a corresponding risk of developing an LCF of 5×10^{-6}, or 1 chance in 200,000 of an LCF.

4.4.1.2 Operations

The operational characteristics at LANL would not change, regardless of the locations of the AC and MC activities. The sampling methods and mission support operations associated with AC and MC would not change and therefore, would not result in generation of operational wastes that were not considered in the *CMRR EIS* (DOE 2003b), *LANL SWEIS* (DOE 2008a), or *CMRR-NF SEIS* (DOE 2011c). Transport of radioactive waste from AC and MC operations to offsite facilities would conservatively require 13 annual shipments to WIPP, 176 annual shipments to a LLW disposal facility, and 2 annual shipments to a MLLW disposal facility (DOE 2011c).

Using the same assumptions regarding radioactive waste transport as those for radioactive waste from facility modifications, **Table 22** shows the potential environmental consequences from transport of TRU waste to WIPP and transport of LLW and MLLW to the facility resulting in the largest consequences (NNSS). Table 22 also shows the potential environmental consequences from transport of all radioactive waste, for which it was assumed that all TRU waste would be transported to WIPP and all LLW and MLLW would be transported to the evaluated disposal facility (NNSS), resulting in the largest potential environmental consequences.

Table 22. Potential Annual Environmental Consequences from Transport of Radioactive Waste from AC and MC Operations

		Incident-Free Transport				*Accident Conditions*	
Waste	*Destination*	*Crew Dose (person-rem)*	*Crew Risk (LCF)* [a]	*Population Dose (person-rem)* [b]	*Population Risk (LCF)* [a,b]	*Radiological Risk (LCF)* [a,b]	*Nonradiological Risk (traffic fatalities)*
TRU	WIPP	0.30	2×10^{-4}	0.095	6×10^{-5}	2×10^{-8}	2.9×10^{-4}
LLW	NNSS [c]	2.2	1×10^{-3}	0.71	4×10^{-4}	9×10^{-8}	6.9×10^{-3}
MLLW	NNSS [c]	0.025	1×10^{-5}	0.0080	5×10^{-6}	1×10^{-9}	7.8×10^{-5}
All waste [c]	Combination with maximum consequences [d]	2.5	2×10^{-3}	0.81	5×10^{-4}	1×10^{-7}	7.2×10^{-3}

AC = analytical chemistry; LCF = latent cancer fatality; LLW = low-level radioactive waste; MC = materials characterization, MLLW = mixed low-level radioactive waste; NNSS = Nevada National Security Site; TRU = transuranic; WIPP = Waste Isolation Pilot Plant.

[a] Determined using a risk of 0.0006 LCF per rem or person-rem (DOE 2003a).

[b] Population radiation doses and risks along the transport routes were evaluated by assuming population growth to 2030.

[c] The largest environmental consequences were determined for transport of LLW or MLLW to NNSS. Transport of LLW or MLLW to Energy*Solutions* in Utah or Waste Control Specialists in Texas would result in smaller environmental consequences.

[d] Consequences were determined by summing the doses and risks from transporting all TRU waste to WIPP and; the doses and risks from transporting all LLW and MLLW to NNSS. As noted in table note c, transport NNSS would result in the largest consequences.

Incident-Free Transport—Table 22 shows that the largest potential consequences would be those for incident-free transport of LLW to NNSS. Even so, because the calculated annual crew and population risks for incident-free transport are both smaller than 1 (1×10^{-3} LCF and 4×10^{-4} LCF, respectively), no LCFs are expected annually among the transport crew or among the population along the transport route. Smaller calculated risks (and no LCFs) are associated with shipment of TRU waste and MLLW. The calculated annual risk to the transport crew for TRU waste shipment is 2×10^{-4} LCF, while the calculated annual risk to the route population is 6×10^{-5} LCF; the calculated annual risk to the transport crew for MLLW shipment is 1×10^{-5} LCF, while the calculated annual risk to the route population is 5×10^{-6} LCF.

Table 22 also shows that incident-free transport of all radioactive waste to the evaluated disposal facilities is not expected to result in an annual LCF among the transport crews or the populations along the transport routes. Transport of all radioactive waste would result in a calculated annual risk to the transport crews of 2×10^{-3} LCF and a calculated annual risk to the populations along the transport routes of 5×10^{-4}. Also note that the radiation dose potentially received by any individual transport worker would be limited in accordance with DOE regulations.

Assuming a member of the public resides along the route traveled by all trucks transporting radioactive waste to offsite disposal facilities, and assuming the same assumptions for this receptor as those for facility modifications, the total dose that this receptor would receive from all offsite shipments of TRU waste, LLW, and MLLW would be about 0.013 millirem per year. This total dose could result in an annual risk of an LCF of about 8×10^{-9} (1 chance in about 125 million of an LCF).

Accident Conditions—Considering all potential accidents from a spectrum of accidents ranging from high-probability accidents of low severity (fender benders) to hypothetical high-severity accidents that have corresponding low probabilities of occurrence, no LCFs are expected annually among the population along the transport route from shipments of LLW (calculated annual risk of 9×10^{-8} LCF). The calculated risk to the population from a fatal traffic accident from transporting all LLW to NNSS is larger than the calculated radiological risk from the spectrum of potential accidents. Still, no accident fatalities are expected annually among the population along the transport route because the calculated annual risk of a fatality is less than 1 (calculated annual risk of 6.9×10^{-3}).

Transport of all radioactive waste is similarly not expected to result in an annual LCF among the affected population due to the spectrum of potential accidents or to result in an annual traffic fatality. The calculated annual radiological risk is 1×10^{-7} LCF, and the calculated annual risk of a traffic fatality is 7.2×10^{-3}.

The maximum reasonably foreseeable offsite truck transportation accident with the greatest consequence would involve a truck carrying TRU waste. The probability that such an accident would occur is about 2.8×10^{-7} (1 chance in about 3.6 million) per year in a suburban area. If such an accident occurred, the consequences would be the same as those evaluated for transport of TRU waste from facility modifications.

4.4.2 Environmental Consequences of the No Action Alternative

4.4.2.1 Facility Modifications

Incident-Free Transport—As shown in Table 21, the potential environmental consequences from incident-free transport of radioactive waste from facility modifications to offsite facilities are comparable to those for the Proposed Action Alternative. The conclusions from the analysis are the same as those for the Proposed Action Alternative. For transport of any or all types of radioactive waste from facility modifications, incident-free transport to offsite facilities would not result in an LCF among the transport crew or the population along the transport routes. Assuming a member of the public resides along the route traveled by all trucks transporting radioactive waste to offsite disposal facilities, and assuming the same assumptions for this receptor as those for facility modifications, the total dose that this receptor would receive from all offsite shipments of TRU waste, LLW, and MLLW would be about 0.0051 millirem. This total dose could result in an annual risk of an LCF of 3×10^{-9} (1 chance in about 330 million of an LCF).

Accident Conditions—As shown in Table 21, the environmental consequences from potential accidents during transport of radioactive waste are comparable to those for the Proposed Action Alternative. The range of potential accidents that could occur during transport of any or all types of radioactive waste to offsite facilities would not result in an LCF among the population along the transport routes. The maximum reasonably foreseeable offsite truck transportation accident with the greatest consequence would involve a truck carrying TRU waste. Conservatively assuming that all TRU waste shipments occurred in a single year, the probability that such an accident could occur is about 3.3×10^{-7} (1 chance in about 3 million) per year in a suburban area. If such an accident occurs, the consequences would be the same as those evaluated for transport of TRU waste from facility modifications (Section 4.4.1.1).

4.4.2.2 Operations

Incident-Free Transport—The potential environmental consequences from incident-free transport of radioactive waste from AC and MC operations to offsite facilities are the same as those under the Proposed Action Alternative (see Table 22). The conclusions from the analysis are also the same as those under the Proposed Action Alternative. For transport of any or all types of radioactive waste from AC and MC operations, incident-free transport to offsite facilities would not result in an LCF among the transport crew or the population along the transport routes. Assuming a member of the public resides along the route traveled by all trucks transporting radioactive waste to offsite disposal facilities, the annual dose and risk that this receptor would receive from all offsite shipments of TRU waste, LLW, and MLLW would be the same as that under the Proposed Action Alternative (Section 4.4.1.2).

Accident Conditions—The environmental consequences from the range of potential accidents that could occur during transport of all types of radioactive waste are the same as those under the Proposed Action Alternative (see Table 22). The maximum reasonably foreseeable offsite truck transportation accident with the greatest consequence would involve a truck carrying TRU waste. The probability that such an accident would occur is about 2.8×10^{-7} (1 chance in about 3.6 million) per year in a suburban area. If such an accident did occur, the consequences would be the same as those evaluated under the Proposed Action Alternative for transport of TRU waste during facility modifications (Section 4.4.1.1).

4.5 Environmental Justice

4.5.1 Affected Environment

The environmental justice analysis for this EA evaluated the potential radiation doses received by affected population groups within 50 miles of PF-4 and RLUOB due to airborne emissions from AC and MC operations. No environmental consequences to members of the public were identified from facility modifications under either alternative. The other resource areas evaluated in this EA are not expected to be meaningful in terms of an environmental justice analysis. Facility modifications and operations would take place within existing structures, and few, if any, impacts are expected for either alternative for the land use, geology and soils, water resources, ecological resources, cultural resources, air quality and climate, visual resources and noise, infrastructure, and socioeconomic resource areas (see Sections 4.6 through 4.14). No impacts to any member of the public are expected from generation and management of waste (see Section 4.3). The potential environmental consequences that could occur due to transport of radioactive waste are small under either alternative (see Section 4.4).

The analysis was performed on total, minority, and low-income population groups in the LANL vicinity, projected to 2030 levels. The total projected population is approximately 488,000 individuals within 50 miles of PF-4 and 497,000 individuals within 50 miles of RLUOB (see Section 4.1.2.2). As shown in **Table 23**, individuals identifying themselves as members of a minority group make up 58 percent of this population. But within 5 and 10 miles of PF-4 and RLUOB, the minority population makes up no more than 38 percent of the population. Low-income individuals within 50 miles of PF-4 and RLUOB comprise no more than 14 percent of the population, and within 5 and 10 miles of these facilities, low-income individuals represent no more than 8 percent of the population.

Table 23. Projected 2030 Populations: PF-4 and RLUOB

Population Groups	*PF-4*				*RLUOB*			
	5-mile	*10-mile*	*20-mile*	*50-mile*	*5-mile*	*10-mile*	*20-mile*	*50-mile*
Total Population	10,524	19,701	63,290	488,152	10,447	19,660	63,381	497,270
Non-Minority	6,524 62%	12,200 62%	21,002 33%	206,436 42%	6,461 62%	12,206 62%	21,127 33%	210,840 42%
Minority	4,000 38%	7,501 38%	42,288 67%	281,716 58%	3,986 38%	7,454 38%	42,254 67%	286,430 58%
Hispanic	2,224 21%	4,022 20%	33,562 53%	229,521 46%	2,224 21%	4,022 20%	33,562 53%	229,521 46%
Native American	186 2%	1,120 6%	4,836 8%	25,137 5%	187 2%	1,083 6%	4,826 8%	25,401 5%
Non-Low-Income	9,716 92%	18,262 93%	52,586 83%	418,460 86%	9,642 92%	18,238 93%	52,686 83%	426,821 86%
Low-Income	808 8%	1,439 7%	10,704 17%	69,692 14%	805 8%	1,422 7%	10,695 17%	70,449 14%

PF-4 = Plutonium Facility, Number 4; RLUOB = Radiological Laboratory/Utility/Office Building.
Note: The total, minority, and low-income populations within a 50 mile radius, as determined from U.S. Census data for 2015 (Census 2017a, 2017b, 2017c, 2017d), were projected to 2030, based on trends in the populations in the counties within a 50-mile radius.

4.5.2 Proposed Action Alternative – Radiological Impacts during Normal Operations

Offsite impacts are shown in **Table 24** for each population group within 5, 10, 20, and 50 miles of the evaluated source of airborne emissions.[31] These impacts, as measured by average individual doses, are highest within 5 and 10 miles of the facilities. At these distances, the percentage of the population that identifies itself as minority is lower than that within the 50-mile population. Although the average individual dose is higher for populations closer to the facilities, there is little difference in the average individual dose among the various population groups within each distance. Average individual doses are roughly an order of magnitude higher within the 5- and 10-mile distances than those for average individuals within a 50-mile distance.

Table 24. Annual Radiation Doses to Average Individuals within Population Groups in the Los Alamos National Laboratory Area under the Proposed Action Alternative (millirem per year)

Population Group	*Within 5 Miles*	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Total Population	0.022	0.015	0.0071	0.0020
Non-Minority	0.021	0.015	0.010	0.0021
Minority	0.022	0.016	0.0056	0.0019
Hispanic [a]	0.023	0.016	0.0050	0.0019
Native American [b]	0.020	0.0099	0.0048	0.0018
Non-Low-Income	0.022	0.015	0.0075	0.0020
Low-Income	0.022	0.016	0.0050	0.0019

[a] The Hispanic population includes all Hispanic persons, regardless of race.
[b] Includes persons who also indicated Hispanic or Latino origin.

[31] As with the population impacts analysis (Section 4.1.2.2 and 4.1.3.2), the impacts were calculated assuming that all emissions from AC and MC operations occurred from RLUOB under the Proposed Action Alternative and from PF-4 under the No Action Alternative.

Within 5 miles of the source of radiological emissions, the potential average annual individual dose is about 0.02 millirem for all population groups and ranges from 0.0099 to 0.016 millirem within a 10-mile distance. Within the 10-mile distance, the average individual doses for the minority, Hispanic, and Native American populations are comparable to or less than the dose for the non-minority population, and the average individual dose for the low-income population is comparable to that for the non-low-income population. Within a 20-mile distance, the average annual individual doses for the minority, Hispanic, and Native American populations are smaller than the dose for the non-minority population, and the average individual dose for the low-income population is smaller than that for the non-low-income population. Within a 50-mile distance, the average individual doses among all population groups are comparable and about 0.002 millirem per year. Based on average annual individual risks, there would be no disproportionally high or adverse impacts to minority or low-income populations.

To investigate the issue of impacts to the Native American community, impacts were assessed for a hypothetical individual residing at the Pueblo de San Ildefonso and Santa Clara Pueblo boundaries, where the greatest potential impacts on Native Americans are expected. For airborne releases, this individual would have the same exposure characteristics as the MEI identified in the evaluation of impacts associated with normal operations. The analysis showed that normal operational releases from RLUOB or PF-4 would result in a maximum dose to the MEI located at the LANL boundary roughly a mile north of PF-4 and RLUOB. Factors contributing to a lower dose for an MEI at either of these pueblos include distance (the nearest Pueblo de San Ildefonso boundary is more than 8.5 miles from PF-4 and RLUOB; the nearest Santa Clara Pueblo boundary is more than 13 miles away) and meteorological conditions (e.g., dominant wind direction). An individual located at the boundary of either of these pueblos would receive an annual individual dose that would be less than the MEI dose of 0.082 millirem under the Proposed Action Alternative or 0.16 millirem under the No Action Alternative. Thus, there would be no disproportionately high and adverse impacts on these individuals.

An analysis of the environmental consequences potentially experienced by a receptor who derives all of his or her food locally and consumes increased amounts of locally obtained fish, deer, elk, and other foods (special pathways receptor) is presented in Chapter 5, Cumulative Impacts.

4.5.3 No Action Alternative – Radiological Impacts during Normal Operations

As under the Proposed Action Alternative, offsite impacts were evaluated as average individual doses for each population group within 5, 10, 20, and 50 miles of the evaluated source of airborne emissions (**Table 25**). These impacts are highest within 5 and 10 miles of the facilities. At these distances, the percentage of the population that identifies itself as minority is lower than that within the 50-mile population. Although the average individual dose is higher for populations closer to the facilities, there is little difference in the average individual dose among the various population groups within each distance. Average individual doses are roughly an order of magnitude higher within the 5- and 10-mile distances than those for average individuals within a 50-mile distance.

Table 25. Annual Radiation Doses to Average Individuals within Population Groups in the Los Alamos National Laboratory Area under the No Action Alternative (millirem per year)

Population Group	*Within 5 Miles*	*Within 10 Miles*	*Within 20 Miles*	*Within 50 Miles*
Total Population	0.031	0.021	0.0094	0.0025
Non-Minority	0.031	0.021	0.014	0.0027
Minority	0.032	0.022	0.0073	0.0024
Hispanic [a]	0.033	0.022	0.0064	0.0023
Native American [b]	0.029	0.013	0.0061	0.0022
Non-Low-Income	0.031	0.021	0.010	0.0025
Low-Income	0.032	0.022	0.0065	0.0023

[a] The Hispanic population includes all Hispanic persons regardless of race.
[b] Includes persons who also indicated Hispanic or Latino origin.

Within 5 miles of the source of radiological emissions, the potential average annual individual dose is about 0.03 millirem for all population groups and ranges from 0.013 to 0.022 millirem within a 10-mile distance. Within the 10-mile distance, the average individual doses for the minority, Hispanic, and Native American populations are comparable to or less than the dose for the non-minority population, and the average individual dose for the low-income population is comparable to that for the non-low-income population. Within a 20-mile distance, the average annual individual doses for the minority, Hispanic, and Native American populations are smaller than the dose for the non-minority population, and the average individual dose for the low-income population is smaller than that for the non-low-income population. Within a 50-mile distance, the average individual doses among all population groups are comparable (about 0.002 to 0.003 millirem per year). Based on average annual individual risks, there would be no disproportionally high or adverse impacts to minority or low-income populations.

The environmental justice analysis performed for the Proposed Action Alternative for Native American communities is applicable to the No Action Alternative. The potential dose that could be received at the boundaries of the Pueblo de San Ildefonso or Santa Clara Pueblo would be essentially the same as that under the No Action Alternative. Thus, there would be no cumulative disproportionately high and adverse human health and environmental effects on an individual hypothetically located at these boundaries.

As under the Proposed Action Alternative, an analysis of the environmental consequences potentially experienced by a receptor deriving all of his or her food locally and consuming increased amounts of locally obtained fish, deer, elk, and other foods (special pathways receptor) is presented in Chapter 5, Cumulative Impacts.

4.6 Land Use

The 47 contiguous TAs at LANL are used for building sites, experimental areas, and waste disposal. About 20 percent of LANL’s 37 square miles of land is developed with facilities and structures, including much of TA-55. Major constraints to further development include factors such as topography, slope, soils, vegetation, geology and seismology, climate, endangered species, archaeological and cultural resources, and surface hydrology. Undeveloped portions of the site provide security, safety, and expansion possibilities for future mission-support requirements (DOE 2011c).

Proposed Action Alternative

Facility Modifications—Trailers and storage structures supporting facility modifications would be located in TA-55 on previously disturbed land, consistent with activities evaluated in the *LANL SWEIS* (DOE 2008a) for subprojects under the TA-55 Reinvestment Project.

Operations—Operations at TA-55 would be consistent with those described in the *LANL SWEIS*.

Conclusion—There would be no newly disturbed land and no change in the land use designation of TA-55. Neither facility modifications nor AC and MC operations would impact land use at LANL.

No Action Alternative

As under the Proposed Action Alternative, there would be no newly disturbed land and no change in the land use designation of TA-55. The same support trailers and storage structures would be temporarily located on previously disturbed land, consistent with activities evaluated in the *LANL SWEIS* for subprojects under the TA-55 Reinvestment Project (DOE 2008a). Therefore, there would be no impact on land use at LANL.

4.7 Geology and Soils

LANL is located on the Pajarito Plateau, which is divided into multiple, narrow, east-southeast-trending mesas, separated by deep parallel canyons. Rocks in the LANL region are volcanic and sedimentary. The youngest surficial geologic units consist of sediment deposited by flowing water (alluvium) and rock debris accumulated at the bases of slopes along stream channels and in canyons (colluvium). A recent description of the seismic environment at LANL is provided in the *SPD Supplemental EIS* (DOE 2015c).

Proposed Action Alternative

Facility Modifications—Facility modifications would occur within existing structures, with no need for aggregate, backfill, or other geologic or soil resources. No discharges to soil are planned, and any accidental spills (such as oil that could drip from trucks delivering equipment or picking up waste) would be remediated.

Operations—Operations would not require use of geologic or soil resources or contaminate soil at LANL.

Conclusion—Because previously undisturbed land would not be affected and there would be no use of geologic or soil resources and no discharges to soil, there would be no impacts on geology and soils.

No Action Alternative

As under the Proposed Action Alternative, facility modifications would occur within existing structures, with no need for aggregate, backfill, or other geologic or soil resources and no discharges to soil. Operations would not require use of geologic or soil resources or contaminate soil at LANL. Because previously undisturbed land would not be affected and there would be no use of geologic or soil resources and no discharges to soil, the No Action Alternative would have no impacts on geology and soils.

4.8 Water Resources

Water resources at LANL encompass the surface and groundwater sources of water suitable for Native American traditional and ceremonial purposes, plant and wildlife propagation, and human endeavors and enterprise. The LANL region includes onsite and offsite water systems that could be affected by effluent discharge and release of stormwater runoff. Changes in the environment can potentially affect hydrologic equilibrium, water quality, and availability of usable water (DOE 2011c).

Proposed Action Alternative

Facility Modifications—No surface water would be used to support facility modifications. Portable toilets or existing facility sanitary systems would be used, resulting in no direct discharge of sanitary wastewater and no impact on surface waters. Support activities for facility modifications would occur within an already disturbed location in an industrial area, where stormwater runoff would be managed in accordance with existing permits. Additional soil erosion and sediment control measures would be implemented, if required, along with spill prevention practices, to minimize any potential dispersion of soil and sediment that could impact surface and subsurface water quality. Applicable requirements of the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Activities would be in place. The facility modification support area is not near a wetland or within a floodplain. The only wetland in TA-55 is at a lower elevation in Mortandad Canyon. The nearest 100-year floodplains are similarly at lower elevations within Two-Mile, Mortandad, and Pajarito Canyons (DOE 2011c).

Water supplied by the Los Alamos County Department of Public Utilities would support facility modifications, rather than water from onsite wells. As addressed in Section 4.13, NNSA expects that groundwater use would be primarily associated with workers performing the modifications. The number of workers performing the modifications would vary considerably over the duration of facility modifications, but could rise to approximately 480 additional FTEs during the peak year of facility modifications (see Section 4.14). As evaluated in Section 4.13, groundwater use by these workers during this peak year could total about 6.2 million gallons of water, a small amount compared to site availability and historic usage. There would be no discharge of wastewater to the subsurface. The scope of the proposed activities would be less than that evaluated in the *CMRR-NF SEIS* (DOE 2011c) for construction of the CMRR-NF, with less need for groundwater.

Operations—There would be no use of surface water and no uncontrolled discharge of wastewater to the surface or subsurface. Although annual consumption of groundwater as supplied by Los Alamos County could slightly increase at RLUOB and PF-4 compared to current demands, this annual increase would be less than that evaluated for the CMRR project in the *CMRR EIS* (DOE 2003b). NNSA expects that the increase in groundwater use would be primarily associated with additional personnel performing AC and MC operations at RLUOB and PF-4. As addressed in Section 4.14, up to 30 additional FTEs may be employed. As evaluated in Section 4.13, an additional 30 FTEs would require about 390,000 gallons of groundwater, a small amount compared to site availability and historic usage.

Conclusion—No meaningful impacts on water resources are expected.

No Action Alternative

No surface water would be used to support facility modification. The same measures would be employed to protect surface water and groundwater resources as those under the Proposed Action Alternative. As with the Proposed Action Alternative, NNSA expects that groundwater use would be primarily associated with workers performing the modifications. Peak employment during facility modifications is expected to be comparable to that under the Proposed Action Alternative, with a comparable requirement for groundwater (about 6.2 million gallons per year), a small amount compared to site availability and historic usage (see Section 4.13) and less than that evaluated in the *CMRR-NF SEIS* for construction of the CMRR-NF.

Groundwater use during AC and MC operations would be comparable to that under the Proposed Action Alternative. The increase in groundwater use would be primarily associated with additional personnel performing AC and MC operations at RLUOB and PF-4 (approximately 30 FTEs). As evaluated in Section 4.13, an additional 30 FTEs would require about 390,000 gallons of groundwater, a small amount compared to site availability and historic usage.

No meaningful impacts on water resources are expected during facility modifications or AC and MC operations.

4.9 Biological Resources

LANL contains diverse ecosystems. Terrestrial animals associated with vegetation zones in the LANL area include 57 species of mammals, 200 species of birds, 28 species of reptiles, 9 species of amphibians, and 1,200 species of arthropods (DOE 2011c). Wetlands within LANL, including a single wetland within TA-55 (in Mortandad Canyon), provide habitat for reptiles, amphibians, and invertebrates (DOE 2011c, 2015a). Because several threatened and endangered species occur (or possibly occur) at LANL, areas of environmental interest have been established at LANL for the Mexican spotted owl, bald eagle,[32] southwestern willow flycatcher, and Jemez Mountain salamander. Portions of TA-55 include both core and buffer zones for the Mexican spotted owl. The areas of environmental interest for the bald eagle, southwestern willow flycatcher, and Jemez Mountain salamander do not include any part of TA-55 (DOE 2015a). Since issuance of the *CMRR EIS* ROD in 2004 (69 FR 6967), several biological assessments were prepared and submitted to the U.S. Fish and Wildlife Service (USFWS). These biological assessments evaluated the potential effects on the Mexican spotted owl from construction of additional buildings, associated parking lots, and laydown yards in LANL TAs, including TA-55 (LANL 2004, 2006, 2007, 2009, 2011). USFWS determined that the proposed construction (as defined in the biological assessments) may affect, but is not likely to adversely affect, the Mexican spotted owl (USFWS 2005, 2006, 2007, 2009, 2011).

[32] Although the bald eagle has been removed from the Federal List of Endangered and Threatened Wildlife in the lower 48 states of the United States, it continues to be protected under the Bald and Golden Eagle Protection Act.

Proposed Action Alternative

Facility Modifications—Facility modifications would be supported by trailers and other structures temporarily located in TA-55, with no additional removal of vegetation or habitat. Because the wetland within TA-55 is not located near the facility modification support area, facility modifications would have little or no effect on LANL wetlands or the aquatic resources that inhabit these wetlands. Sediment and erosion control plans (e.g., measures to remove soil or mud from trucks departing the work site) would be implemented to control stormwater runoff.

As discussed above, several biological assessments and USFWS determinations have addressed the potential impacts on threatened and endangered species from proposed construction activities at LANL. No exterior building construction would be required under the Proposed Action Alternative. Other than increased traffic during the years of facility modifications, the only change from current conditions at TA-55 would be use of a previously disturbed exterior area to support modifications within existing structures.

Operations—Previously undisturbed land would not be affected, and there would be no uncontrolled discharge to soil, surface water, or groundwater. The wetland in TA-55 would not be affected. Adverse conditions such as traffic, lighting, and noise at TA-55 that could affect threatened and endangered species would not be meaningfully different than existing conditions.

Conclusion—Facility modifications and AC and MC operations would have little or no effects on biological resources, including threatened and endangered species.

No Action Alternative

The same types of facility modifications would occur as those under the Proposed Action Alternative, with little or no effect on wetlands or the aquatic resources that inhabit these wetlands. Other than increased traffic during the years of facility modifications, the only change from current conditions at TA-55 would be use of a previously disturbed area to support modifications within existing structures. Adverse operational conditions at TA-55 (e.g., traffic, lighting, and noise) that could affect threatened and endangered species would not be meaningfully different than existing conditions. Therefore, facility modifications and AC and MC operations under the No Action Alternative would have little or no effects on biological resources, including threatened and endangered species.

4.10 Cultural Resources

Cultural resources are human imprints on the landscape that are defined and protected by a series of Federal laws, regulations, and guidelines. Cultural resources include archaeological resources, such as paleontological resources and prehistoric sites; traditional cultural properties, such as ancestral villages, petroglyphs, or traditional use areas; and historical resources, such as buildings that date back to the Manhattan Project or the early Cold War period (DOE 2011c).

Proposed Action Alternative

Facility Modifications—No archaeological resources or traditional cultural properties have been identified in the previously disturbed area where facility modification support activities would occur. Thus, it is unlikely that an inadvertent discovery of archaeological resources or traditional cultural properties would be made.

PF-4 is considered potentially eligible for listing in the *National Register of Historic Places* because it was built during the Cold War period of significance and has yet to be reviewed for eligibility. Under the National Historic Preservation Act, properties considered potentially eligible for listing in the *National Register of Historic Places* must be managed as if they are eligible for listing until formal determinations are made. Modifications to PF-4 are tracked by cultural resources staff. As appropriate, NNSA would consult with the State Historic Preservation Officer and, if necessary, collect data and recover artifacts.

Operations—No additional land disturbance would occur. Operations would take place within existing but modified structures.

Conclusion—No effects on cultural resources are expected.

No Action Alternative

As under the Proposed Action Alternative, facility modification support activities would take place in a previously disturbed area with no expected impacts on archaeological resources or traditional cultural properties. AC and MC operations would not require additional land disturbance and would take place within existing but modified structures. No effects on cultural resources are expected.

4.11 Air Quality and Climate Change

This section evaluates the potential environmental consequences due to emissions of nonradiological pollutants to the air, as well as climate change due to atmospheric release of greenhouse gases. The potential environmental consequences due to emissions of radiological material to the air are discussed in Section 4.1.

Air Quality—Air quality is determined by the type and amount of the pollutants emitted into the atmosphere, the size and topography of the air basin, and prevailing meteorological conditions. The baseline standards for pollutant concentrations are the National Ambient Air Quality Standards (NAAQS) and state air quality standards. Areas like LANL that demonstrate compliance with NAAQS are considered "attainment areas," while areas that are not in compliance with NAAQS are known as "nonattainment areas." Air quality permits have been obtained from the New Mexico Environment Department's Air Quality Bureau for various activities at LANL. In accordance with Title V of the Clean Air Act and New Mexico Administrative Code 20.2.70, a site-wide operating permit is in place at LANL. **Table 26** summarizes the average emissions of four criteria air pollutants for the years 2011 through 2014 and compares them against the emission projections in the *LANL SWEIS* (DOE 2008a) and against LANL's Title V permit limits. As shown, the average emissions for all four pollutants during these 5 years were less than the projections in the *LANL SWEIS* and less than LANL's Title V permit limits.

Table 26. Five-Year Average Emissions of Pollutants to the Air from Los Alamos National Laboratory

Pollutant	*Average Emissions (tons per year)*	*Percent of Projections in the LANL SWEIS*	*Percent of Title V Permit Limit*
Carbon Monoxide	33	57	15
Nitrogen Oxides	47	24	19
Particulate Matter	4	40	4
Sulfur Oxides	0.88	90	0.59

LANL SWEIS = Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (DOE 2008a).
Source: LANL 2012, 2013a, 2013b, 2015, 2016b.

Climate Change—In 2014, the White House Office of the Press Secretary published *Fact Sheet: What Climate Change Means for New Mexico and the Southwest*, which presents selected findings and information from the Third U.S. National Climate Assessment that are relevant to New Mexico. Increased temperatures and decreased precipitation resulting from climate change would impact agriculture, water, health, ecosystems, tribes, and adaptation both directly and indirectly (WH 2014).

Climate change impacts on LANL operations would be similar to those that may occur in the southwest region, with the magnitude and significance of the impacts increasing over time. Direct impacts are expected to include a decrease in the availability of water, increased demand for electricity for cooling, decreased demand for electricity and fuel for heating, and a potentially greater level of maintenance on infrastructure (for example, repairing roadways damaged by higher temperatures, wildfires, or flooding). Seasonal hot weather, seasonal flooding from rain and snowmelt, and wildfires are current environmental phenomena that could potentially affect operations. Fire models project more wildfire and increased risks to communities due to increased warming and drought (WH 2014). The timing or design of some activities at LANL may need to change to accommodate changed environmental conditions.

Low water levels for the nearby hydroelectric plants and possible upgrades to the coal-burning generators are likely future impacts facing LANL (LANL 2014). Switching from coal and carbon-based generation to renewable and non-carbon electrical generation would likely increase the cost of electricity, but would help mitigate climate impacts. In FY 2014, LANL reduced its Scope 1 and 2 greenhouse gas emissions by 19 percent compared to FY 2008.[33] These reductions were mainly achieved by purchasing renewable energy credits and reducing electricity use (LANL 2014). In FY 2014, LANL also exceeded its 7.5 percent renewable energy goal. Approximately 12 percent of LANL's electricity consumption during this year came from renewable sources (LANL 2014). During the years 2011 through 2014, LANL activities caused an average annual emission of 63,700 tons of carbon dioxide equivalent (LANL 2012, 2013a, 2013b, 2015, 2016b).

Proposed Action Alternative

Facility Modifications—Facility modifications within existing buildings would primarily involve the use of electric power tools, with negligible emissions. Therefore, criteria air pollutants would be generated primarily from fugitive dust (particulate matter) and tailpipe emissions from trucks and employee vehicles. Fugitive dust would be primarily generated from trucks and personnel operating in a support area next to RLUOB. This support area is covered with gravel, and generation of dust in the area would be controlled. During the peak year of facility modifications, the number of personnel employed at LANL could increase by approximately 480 workers (see Section 4.14), which would represent about 4.5 percent of the LANL workforce in 2016. Assuming one vehicle for each employee, the number of vehicles accessing LANL and their associated emissions would increase by the same small percentage. Nonetheless, emissions and contributions from fugitive dust would be less than those evaluated in the *CMRR EIS* (DOE 2003b) because of the reduced construction scope evaluated in this EA compared to that of the CMRR project. As stated in the *CMRR EIS*, overall air quality would remain within applicable standards and, because LANL is in an attainment area, the General Conformity rule does not apply and no conformity analysis is required (DOE 2003b). As summarized in Table 26, from 2010 through 2014, emissions of criteria pollutants (carbon monoxide, nitrogen oxides, particulate matter, and sulfur oxides) from all LANL activities averaged no more than 19 percent of their Title V permit limits (LANL 2012, 2013a, 2013b, 2015, 2016b). The increases in emissions due to the activities evaluated under the Proposed Action Alternative would be small and thus are not expected to cause LANL to exceed its Title V emission limits for criteria pollutants.

Operations—Criteria air pollutants would be emitted primarily from periodic tests of emergency generators and from employee vehicles. Activities under the Proposed Action Alternative would not alter the test protocols for emergency generators at RLUOB and PF-4, and there would be no changes in criteria air emissions from these tests.

Employment under the Proposed Action Alternative is expected to increase by up to 30 FTEs (see Section 4.14), which would result in a potential increase in annual emissions from employee vehicles. However, this increase in employment would represent about 0.3 percent of the LANL workforce in 2016. Assuming one vehicle for each employee, the number of vehicles accessing LANL and their associated emissions would increase by the same small percentage. Furthermore, there would be

[33] Scope 1 emissions are direct emissions from owned or controlled sources; Scope 2 emissions are indirect emissions from the generation of purchased energy.

decreased personnel requirements at RLUOB and PF-4 compared to those evaluated for the CMRR project (DOE 2003b), with corresponding decreases in annual emissions from employee vehicles. Any additional air emissions from operations are not expected to have a significant effect on the location and severity of impacts on downwind receptors such as the Royal Crest Trailer Park or the northern boundary of the LANL site.

Climate Change—During facility modifications, there would be very minor emissions of Scope 2 greenhouse gases due to use of electric powered tools; however, electricity use at RLUOB and PF-4 would primarily involve activities (such as lighting) that are independent of the modifications. Similarly, emissions of greenhouse gases due to use of natural gas for activities such as building heat would occur independently of the modifications. The principal emissions of greenhouse gases would primarily result from personally owned vehicles accessing LANL in support of the modifications. (On a daily basis, the number of personnel vehicles accessing LANL would be much larger than the number of trucks accessing LANL and supporting facility modifications.) The *CMRR-NF SEIS* (DOE 2011c) estimated that a construction workforce of 420 would result in an annual emission of about 1,280 tons of carbon dioxide equivalent due to personnel vehicles and busses transporting workers to and from the work site (DOE 2011c). Extrapolating to an assumed peak-year workforce of 480 (see Section 4.14), peak-year emissions of greenhouse gases from facility modifications would be approximately 1,460 tons of carbon dioxide equivalent, which would represent about 2 percent of LANL's 5-year average emissions of greenhouse gases from 2011 through 2014.

During AC and MC operations, there could be small additions to electrical use at PF-4 and RLUOB, which could result in small additions to Scope 2 emissions due to electricity use. However, electricity use at RLUOB and PF-4 would primarily involve activities (such as lighting) that are independent of AC and MC operations. Similarly, emissions of greenhouse gases due to use of natural gas for activities such as building heat would occur independently of AC and MC operations. There would be no change from current emissions of greenhouse gases from periodic tests of emergency electrical generators at RLUOB and PF-4. Assuming AC and MC operations at RLUOB and PF-4 would require up to 30 additional employees (see Section 4.14) and each employee drove a personal vehicle to LANL, annual greenhouse emissions due to these employee vehicles would be approximately 90 tons of carbon dioxide equivalent. These emissions would represent approximately 0.1 percent of LANL's 5-year average emissions of greenhouse gases from 2011 through 2014.

No Action Alternative

Facility Modifications—Annual nonradiological and radiological emissions would be comparable to those under the Proposed Action Alternative because essentially the same types of activities would take place at PF-4 and RLUOB, and the peak number of additional personnel required to perform facility modifications would be thus comparable (see Section 4.14). Increases in nonradiological emissions due to the activities evaluated under the No Action Alternative would be smaller than those evaluated in the *CMRR EIS* (DOE 2003b) and are not expected to cause LANL to exceed its Title V emission limits for criteria pollutants.

Operations—As under the Proposed Action Alternative, activities under the No Action Alternative would not alter the test protocols for emergency generators, and there would be no changes in criteria air emissions from these tests. There would be a comparable number of new hires to perform AC and MC operations (see Section 4.14), resulting in a comparable minor increase in annual nonradiological emissions from employee vehicles. There would be decreased personnel requirements at RLUOB and PF-4 compared to the CMRR project (DOE 2003b), with corresponding decreases in annual emissions from employee vehicles. Air emissions are not expected to have a significant effect on the location and severity of impacts on downwind receptors such as the Royal Crest Trailer Park or the northern boundary of the LANL site.

Climate Change—Impacts would be the same as those under the Proposed Action Alternative.

4.12 Visual Resources and Noise

For security reasons, much of the development within LANL, which is generally austere and utilitarian, has occurred out of the view of the public, and passing motorists or nearby residents can see only a small portion of what is actually on site. Much of TA-55 is developed. The three-story RLUOB building is visible from a number of locations throughout LANL and is the key visible structure along Pajarito Road; however, views from Pajarito Road are limited to LANL workers because the road is generally closed to the public (DOE 2011c).

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Existing noise related to LANL facilities that is detectable by the public comes from a variety of sources, including activities that are not associated with the two alternatives evaluated in this EA, such as construction, high-explosive testing, and firearms practice by security guards. Noise from the alternatives evaluated in this EA is expected to primarily result from truck and automobile movements within LANL. Non-LANL noise occurring within Los Alamos County is also dominated by traffic movement (DOE 2011c).

Proposed Action Alternative

Facility Modifications—The appearance of an area within the already industrialized TA-55 would change due to the presence of support trailers and storage structures and the arrival and departure of trucks. There would also be an increase in noise levels in TA-55 from the arrival and departure of trucks and personnel vehicles. As evaluated in Section 4.11, during the peak year of facility modifications, the number of vehicles accessing LANL could increase by about 4.5 percent. However, the quality of this vehicle noise would be comparable to current conditions and is not expected to result in a change in noise impacts outside the LANL boundary. Facility modifications would take place within existing buildings, with no expected change in noise impacts outside these buildings.

Operations—Because RLUOB and PF-4 are both located in the already industrialized TA-55, their operation would present no change from current visual conditions. Operational noise from RLUOB and PF-4 would be the same as current levels, with the only meaningful potential for increased noise arising from a slightly increased daily number of employee vehicles. As evaluated in Section 4.11, the number of vehicles accessing LANL could increase by about 0.3 percent. The small addition to noise from these additional vehicles would be the same quality as current conditions and is not expected to change noise impacts outside the LANL boundary.

Conclusion—Neither facility modifications nor AC and MC operations would have meaningful impacts on visual resources in TA-55 or change noise impacts outside the LANL boundary.

No Action Alternative

As evaluated under the Proposed Action Alternative, an area within the already industrialized TA-55 would contain support trailers and storage structures, as well as arriving and departing trucks. Noise from the arrival and departure of trucks and personnel vehicles would be the same in terms of intensity as that under the Proposed Action Alternative. Facility modifications would take place within existing buildings, with no expected change in noise impacts outside these buildings.

As under the Proposed Action Alternative, operation of RLUOB and PF-4 would not change the current visual environment. Operational noise associated with RLUOB and PF-4 would be essentially the same as current levels, with the only meaningful potential for increased noise arising from a slightly increased daily number of employee vehicles compared to that under current operations. This increased noise would be comparable to that evaluated under the Proposed Action Alternative. Therefore, neither facility modifications nor AC and MC operations would have meaningful impacts on visual resources in TA-55 or change noise impacts outside the LANL boundary.

4.13 Infrastructure

LANL infrastructure includes a transportation network (roads) and a supply and distribution network for natural gas, electricity, and water. About 80 miles of paved roads and parking surfaces have been developed at LANL; there are no railway connections. Natural gas is the primary heating fuel at LANL and in Los Alamos County. Electrical service to LANL is supplied using two existing regional 115-kilowatt electric power lines through a cooperative arrangement with Los Alamos County. Water at LANL is supplied through a network of wells, distribution lines, pump stations, and storage tanks. **Table 27** lists the LANL capacities for gas use, electricity, and water per the *LANL SWEIS* (DOE 2008a) and compares the actual use of these facilities with the listed capacities for the years 2010 through 2014, as published in the most recent *LANL SWEIS* yearbooks (LANL 2012a, 2013a, 2013b, 2015, 2016b). For all 5 years, the actual use of the listed utilities was a fraction of the LANL capacities.

Table 27. Annual Utility Use as a Percent of Los Alamos National Laboratory Site Capacity

Utility	*Units*	*Capacity*	*Utility Use as Percent of Capacity*					
			2010	*2011*	*2012*	*2013*	*2014*	*Average*
Gas	Decatherms [a]	8,070,000	14	13	14	13	11	13
Electricity	Megawatt-hours	1,314,000	32	34	34	33	30	33
Water	Million gallons	1,806	23	24	25	20	16	22

[a] A decatherm is 1,000 cubic feet of natural gas.
Source: DOE 2008a; LANL 2012, 2013a, 2013b, 2015, 2016b.

Proposed Action Alternative

Facility Modifications—There would be minor increases in utility demands during facility modifications. Electricity use (e.g., for power tools) would be minor compared to other facility uses (such as lighting) that are independent of facility modifications. Natural gas is used for activities (such as heating) that are essentially independent of the facility modifications, and little additional use of gas is expected. Additional water use would be primarily associated with the workers conducting the modifications. Assuming that all workers would be additional to those currently employed at RLUOB and PF-4, a daily average water use of 50 gallons, 260 worker days per year (DOE 2011c), and a peak of approximately 480 FTEs (Section 4.14), the peak water use for facility modifications would be about 6.2 million gallons per year. This peak annual water use would amount to only about 0.3 percent of the LANL water supply capacity.

Operations—AC and MC operations are less encompassing in scope than the activities evaluated in the *CMRR EIS* (DOE 2003b) for the CMR project. Although utility demands could increase slightly compared to current needs at TA-55, the same types of AC and MC operations would occur as those evaluated in the *2015 CMRR SA* (DOE 2015a). DOE determined in that NEPA document that additional utility use for AC and MC operations would not exceed LANL capacities. Furthermore, utility use for AC and MC operations under this alternative could be smaller than that evaluated in the *2015 CMRR SA* because more AC and MC operations would be performed in RLUOB, a modern, Leadership in Energy and Environmental Design (LEED)-designated building. Operational utility increases at TA-55 would be offset by operational utility decreases at the CMR Building.

NNSA expects that the largest increase in utility demands would be increased water use that is primarily associated with increased personnel requirements for AC and MC operations under this alternative (approximately 30 FTEs; see Section 4.14). Given the same assumptions for water use as those for facility modifications, an increase of 30 FTEs at LANL would result in an increase in annual water use of about 390,000 gallons. This increase would represent about 0.02 percent of the LANL water capacity.

Conclusion—There would be no meaningful additional use of utilities such as gas, electricity, or water. Although there would be a small increase over current utility demands to support facility modifications and operations, these increases would not exceed LANL site capacities.

No Action Alternative

Increases in annual utility demands during facility modifications are expected to be comparable to those evaluated under the Proposed Action Alternative. Annual electricity use would be comparable overall because the same types of electric power tools would be used as those under the Proposed Action Alternative, and greater use of these tools at RLUOB would be countered by less use of these tools at PF-4. Little natural gas would be used for the same reason as under the Proposed Action Alternative. Peak annual water use would be comparable because the peak number of workers required for facility modifications would be comparable (see Section 4.14).

There would be a small increase in operational utility demands at RLUOB and PF-4, consistent with that evaluated in the *2015 CMRR SA*, but as determined in that NEPA document, there would be no impacts on LANL capacities. As under the Proposed Action Alternative, NNSA expects that the largest increase in utility demands would be increased water use associated with personnel requirements for AC and MC operations. Because personnel requirements for AC and MC operations under this alternative would be comparable, the increase in water use would also be comparable and well within LANL's water capacity.

4.14 Socioeconomics

The socioeconomic region of influence (ROI) for LANL is defined as the four-county area of Los Alamos, Rio Arriba, Sandoval, and Santa Fe Counties in New Mexico (DOE 2015a). The majority of LANL employees reside in this four-county area. As of 2016, total direct LANL employment was about 10,500 (LANL 2016a), representing about 6 percent of the employment in the LANL ROI, which totaled about 163,000 in 2011 (DOE 2015c). Direct LANL employment causes an approximately equal level of indirect employment in the LANL ROI, assuming an employment multiplier for the LANL area of 2 (DOE 2015c).

Proposed Action Alternative

Facility Modifications—Facility modification personnel would include a combination of resident TA-55 technicians, outside project subcontract workers, and technical experts for equipment installation. Although some of the workforce would come from existing LANL staff, it was assumed that current LANL personnel would be largely committed to other projects and the required personnel would represent new hires.

The total time required to complete facility modifications at both facilities is uncertain because it depends on a variety of factors such as funding, the time required to design and fabricate enclosures, and the scheduling of tasks at PF-4 and RLUOB (e.g., whether installations in the different RLUOB laboratories or PF-4 rooms can be conducted concurrently or sequentially). The total time required for facility modifications at both facilities is expected to be approximately 7 to 9 years (LANL 2018).

Personnel requirements for facility modifications would vary from year to year, comparable to that evaluated for RLUOB and PF-4 modifications in the *2015 CMRR SA* (DOE 2015a). That is, the number of personnel required for facility modifications is expected to range from about 100 FTEs to about 480 FTEs.[34] The peak personnel requirement (approximately 480 workers) would represent about 5 percent of the LANL workforce in 2016 and about 0.3 percent of the workforce in the LANL ROI. This peak personnel requirement would be less than that analyzed in the *CMRR-NF SEIS* (about 790 FTEs)

[34] A peak personnel requirement (477 FTEs) during facility modifications was evaluated for activities evaluated in the *2015 CMRR SA* (DOE 2015a).

(DOE 2011c) for construction of CMRR-NF. The additional personnel at LANL would generate an approximately equal number of indirect jobs in the LANL ROI. After the facility modifications are complete, there could be a minor requirement for personnel over a few years to complete readiness reviews and bring AC and MC activities up to full operations.

Operations—To support AC and MC operations at PF-4 and RLUOB, several personnel would be transferred from the CMR Building, and up to 30 FTEs would be new hires. This estimate of 30 additional employees is expected to be conservative because it is the same estimate as that in the *2015 CMRR SA* (DOE 2015a), which evaluated more AC and MC operations in PF-4 than those under the Proposed Action Alternative. Performing the same AC and MC operations in RLUOB rather than PF-4 may require fewer employees due to the less-extensive safeguards and security requirements at RLUOB compared to those for PF-4 (a Hazard Category 2 Nuclear Facility). Using the same estimates of the LANL and regional workforces as those for the above facility modification analysis, 30 new hires would represent about 0.2 percent of the LANL workforce and 0.02 percent of the employment in the LANL ROI. The additional 30 personnel at LANL would generate an approximately equal number of indirect jobs in the LANL ROI (DOE 2015c).

Conclusion—Facility modifications would cause increased temporary employment at LANL for facility modifications, but at levels lower than previously analyzed (DOE 2011c). Additional employment to support AC and MC operations may be smaller than that evaluated in the *CMRR EIS* (DOE 2003b). There would be little or no stress on housing and community services in the LANL ROI and no meaningful socioeconomic impacts.

No Action Alternative

Modifications to RLUOB and PF-4 are expected to require 8 to 10 years, with most of the work being done in 7 years. This estimate includes minor work following facility modifications and readiness reviews and bringing AC and MC activities up to full operations (DOE 2015a; LANL 2018). Similar activities would take place under the No Action Alternative as those under the Proposed Action Alternative, except that additional modifications would be made to RLUOB and fewer modifications would be made to PF-4. As under the Proposed Action Alternative, personnel requirements for facility modifications would vary from year to year, but are expected to peak at about 480 FTEs. This peak personnel requirement would be less than that analyzed in the *CMRR-NF SEIS* (DOE 2011c) and represent about 4.5 percent of the LANL workforce and about 0.3 percent of the workforce in the LANL ROI. The additional personnel at LANL would generate an approximately equal number of indirect jobs in the LANL ROI (DOE 2015c).

Personnel requirements during AC and MC operations would be essentially the same as those under the Proposed Action Alternative. As evaluated in the *2015 CMRR SA* (DOE 2015a), there would be about 30 new hires to perform AC and MC operations. These new hires would cause little or no stress on housing and community services in the LANL ROI and no meaningful socioeconomic impacts.

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5.0 CUMULATIVE IMPACTS

CEQ regulations (40 CFR Parts 1500–1508) define cumulative impacts as effects on the environment that result from implementing a proposed Federal action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 CFR 1508.7). Thus, the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action, as well as all other actions affecting that resource, no matter what entity (Federal, non-Federal, or private) is taking the action (EPA 1999b).

Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time. Cumulative effects can also result from spatial (geographic) and/or temporal (time) crowding of environmental perturbations (i.e., concurrent human activities and the resulting impacts on the environment are additive if there is insufficient time for the environment to recover).

In general, the following approach was used to estimate cumulative impacts for this EA:

- The affected environment and baseline conditions were identified. Most of this information was taken from Chapter 4 of this EA.
- Past, present, and reasonably foreseeable actions and the effects of those actions were identified.
- Aggregate (additive) effects of past, present, and reasonably foreseeable actions were assessed.

Cumulative impacts were assessed by combining the range of effects of the two alternatives addressed in this EA with the effects of other past, present, and reasonably foreseeable actions in the LANL ROI. Many of these actions would occur at different times and locations and may not be truly additive. The effects were combined, irrespective of the time and location of the impact, to envelop any uncertainties in the projected activities and their effects. This approach produces a conservative estimation of cumulative impacts for the activities considered.

5.1 Other Activities at Los Alamos National Laboratory

Reasonably foreseeable future actions at LANL are summarized in the following paragraphs. The actions listed may not include all actions at LANL. However, they should provide an adequate basis for determining the magnitude of the potential cumulative impacts.

Land Conveyance and Transfer Program—In the *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico*, DOE/EIS-0293 (DOE 1999), DOE evaluated the environmental impacts of the conveyance and transfer of surplus land to other agencies. Several RODs (65 FR 14952, 67 FR 45495, 70 FR 48378, 77 FR 3257) have been issued in support of these actions. DOE has transferred more than 2,430 acres with an additional 1,700 acres scheduled for transfer over the next 10 years (DOE 2016d). The program is not expected to significantly affect the analyses in this EA.

Radioactive Liquid Waste Treatment Facility—The RLWTF Upgrade Project will upgrade the capabilities provided by the RLWTF to collect, store, treat, and dispose of up to 1.3 million gallons per year of liquid LLW and industrial wastewater and 7,700 gallons per year of liquid TRU waste. Activities associated with this ongoing project were evaluated in the *LANL SWEIS* (DOE 2008a). The project scope includes the following subprojects (DOE 2016d):

- *LLW Subproject*: This subproject involves construction of a less than Hazard Category 3 Nuclear Facility for treatment of liquid LLW. The subproject includes facility/infrastructure and LLW treatment process piping; secondary waste treatment (including storage, treatment, and packaging); treated effluent storage, reuse, and discharge; receipt and storage of chemicals; a laboratory for process sample analysis; secondary solid waste storage and handling; and electrical/control/data transmission and receipt of equipment associated with LLW influent storage, treatment processes, and effluent storage/discharge and shipment of solid waste. This subproject is ongoing, with equipment installation and tie-ins to liquid LLW lines already underway.

- *TRU Liquid Waste Subproject*: This subproject involves construction of a Hazard Category 3 Nuclear Facility for storage of liquid TRU waste influent, treatment for the removal of TRU elements, and transfer to LLW treatment. The subproject includes facility/infrastructure and liquid TRU waste treatment process piping; secondary waste treatment (including storage, treatment, and packaging); treated effluent transfer; receipt and storage of chemicals; secondary solid waste storage and handling; and electrical/control/data transmission and receipt of equipment associated with liquid TRU waste influent storage, treatment processes, and effluent transfer and shipment of solid waste.
- *Zero Liquid Discharge Subproject*: This subproject involves construction of evaporation tanks; transfer lines and pumping from existing and new (i.e., proposed) radioactive liquid waste facilities; and discharge capabilities for off-normal events. The subproject constitutes a best management practice.

Surplus Plutonium Disposition Program—The *SPD Supplemental EIS* (DOE/EIS-0283-S2) (DOE 2015c) addresses disposition of 13.1 metric tons of surplus plutonium composed of 7.1 metric tons of plutonium from pits and 6 metric tons of non-pit plutonium. The *SPD Supplemental EIS* alternatives for disposition of surplus plutonium are: (1) fabrication into mixed oxide (MOX) fuel at the MOX Fuel Fabrication Facility at the Savannah River Site (SRS); (2) immobilization using a new vitrification capability at SRS, followed by vitrification with high-level radioactive waste at the SRS Defense Waste Processing Facility; (3) dissolution at the H-Canyon/HB-Line at SRS, followed by vitrification at the Defense Waste Processing Facility; or (4) preparation at SRS or LANL for disposal as TRU waste at WIPP. In addition, the *SPD Supplemental EIS* evaluated the impacts of options for disassembly and conversion of the pit plutonium, including use of newly constructed and existing facilities at SRS and LANL (DOE 2015c).

DOE did not identify a Preferred Alternative in the *SPD Supplemental EIS*. On December 24, 2015, DOE announced a Preferred Alternative for the 6 metric tons of surplus non-pit plutonium (80 FR 80348), which is to prepare this plutonium at SRS for disposal at WIPP. In its April 5, 2016, ROD (81 FR 19588), DOE decided to implement its Preferred Alternative to prepare 6 metric tons of non-pit plutonium for disposal at WIPP. DOE has no Preferred Alternative for dispositioning the remaining 7.1 metric tons of surplus pit plutonium and no Preferred Alternative for providing the capability to disassemble surplus pits and convert pit plutonium to a form suitable for disposition.

Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste—In January 2016, DOE issued the *Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste* (*GTCC LLW EIS*) (DOE/EIS-0375) (DOE 2016d) to evaluate the potential environmental impacts from the proposed development, operation, and long-term management of a facility or facilities for disposal of GTCC LLW and DOE GTCC-like waste. GTCC LLW has radionuclide concentrations exceeding the limits for Class C LLW that were established by the U.S. Nuclear Regulatory Commission in 10 CFR Part 61. DOE GTCC-like waste has similar characteristics. There is no location for disposal of GTCC LLW, and the Federal government is responsible for such disposal under the Low-Level Radioactive Waste Policy Amendments Act of 1985 (Public Law 99-240). The *GTCC LLW EIS* evaluates several disposal technologies, including a geologic repository, intermediate depth boreholes, enhanced near-surface trenches, and above-grade vaults. LANL is one of the six candidate DOE sites considered for GTCC LLW disposal in the *GTCC LLW EIS* (Disposal at LANL would occur at TA-54.) DOE also considered two disposal locations in the WIPP vicinity and generic commercial sites in four regions of the country.

The Preferred Alternative is to dispose of GTCC and GTCC-like waste in the WIPP geologic repository (Alternative 2) and/or at generic commercial facilities (Alternatives 3-5). The land disposal conceptual designs evaluated in the *GTCC LLW EIS* could be altered or enhanced, as necessary, to provide the optimal application at a given location. Before implementing any alternative examined in the *GTCC LLW EIS*, DOE would conduct site-specific NEPA reviews, as appropriate, to identify the location or locations within a given site for a geologic repository, intermediate-depth borehole, trench, or vault facility for the disposal of GTCC LLW and GTCC-like waste.

Cleanup Activities—Cleanup activities are being conducted in compliance with Federal and state regulations. These activities may have short-term adverse impacts, but will have long-term beneficial impacts on the environment. Cleanup activities were evaluated in the *LANL SWEIS* (DOE 2008a) and are not expected to significantly affect the analyses in this EA.

5.2 Other Activities in the Region

It is necessary to consider past, present, and future activities implemented by other Federal, state, and local agencies outside LANL, but within its ROI. Past and present activities are generally reflected in the affected environment information described in Chapter 4. Most of the future actions at locations outside LANL are not expected to affect the cumulative impacts of LANL activities because of their distance from LANL, their relatively small size, and their zoning, permitting, environmental review, and construction and operations requirements.

The main facility at Sandia National Laboratories (SNL) in Albuquerque is located approximately 60 miles from LANL. Due to this distance, cumulative impacts other than air emissions are not expected to be influenced by SNL. For radiological air emissions, the 2015 SNL dose to the offsite MEI was estimated to be 0.003 millirem, and the population dose was estimated to be 0.085 person-rem (SNL 2016). Because any combined impacts would be very small, impacts from SNL are not considered further in this cumulative impacts analysis.

5.3 Cumulative Impacts at Los Alamos National Laboratory

As described in Chapter 4, the actions evaluated in this EA would cause little or no impacts on land use; geology and soils; water resources; biological resources; cultural resources; air quality and climate, visual resources and noise; infrastructure; and socioeconomics. Because the actions evaluated in this EA would produce little or no impacts on these resource areas, they would not substantially contribute to cumulative impacts. Thus, this section analyzes cumulative impacts on human health, waste management, and environmental justice. In addition, nationwide cumulative impacts on transportation and climate change are presented in Section 5.4.

Public and Occupational Health and Safety

Table 28 presents the estimated cumulative impacts of radiation exposure under the *LANL SWEIS* Expanded Operations Alternative (DOE 2008a), doses associated with potential surplus plutonium disposition alternatives (DOE 2015c), doses associated with potential disposal of GTCC LLW at LANL (DOE 2016d), and doses associated with activities at RLUOB and PF-4 under the range of alternatives evaluated in this EA. The estimated doses under the *LANL SWEIS* Expanded Operations Alternative, which reflects the highest level of operations that is expected to occur at LANL, represent a conservative estimate of the doses that could result from ongoing LANL activities because they include doses associated with the continued operation of the Los Alamos Neutron Science Center (LANSCE) and ongoing remediation of material disposal areas (MDAs) at LANL. Operation of LANSCE is the predominant contributor to offsite dose to the population surrounding LANL. Remediation of MDAs at LANL is the predominant contributor to worker dose. In addition, the *LANL SWEIS* totals include operation of the CMRR Facility, and this analysis does not make any adjustment for the reduction in dose that would be realized when the existing CMR Building is completely shut down.

Table 28. Estimated Cumulative Radiological Impacts from Normal Operations

Action	*Maximally Exposed Individual*		*Population Within 50 Miles*		*Site Workers*	
	Dose (millirem per year)	*LCF Risk per Year* [a]	*Collective Dose (person-rem per year)*	*Excess LCFs per Year* [a]	*Collective Dose (person-rem per year)*	*Excess LCFs per Year* [a]
LANL SWEIS Expanded Operations Alternative (DOE 2008a)	8.2	5×10^{-6}	36	0 (0.02)	543	0 (0.3)
SPD Supplemental EIS (DOE 2015c)	0.081	5×10^{-8}	0.21	0 (1×10^{-4})	190	0 (0.1)
GTCC LLW EIS (DOE 2016d)	NA	NA	NA	NA	5.2	0 (0.003)
Alternatives Evaluated in this EA [b]	0.082 to 0.16	5×10^{-8} to 1×10^{-7}	0.98 to 1.2	0 (6×10^{-4} to 7×10^{-4})	9.5 to 11	0 (0.006 to 0.007)
Total LANL Dose	8.5	5.0×10^{-6}	37	0 (0.02)	749	0 (0.4)

EA = environmental assessment; LCF = latent cancer fatality; LLW = low-level radioactive waste; NA = not available.

[a] The risk of an LCF to a MEI is a value less than or equal to 1. The risk to the population within a 50-mile radius or to site workers is the projected number of LCFs in the 50-mile radius or worker population and is a whole number; the calculated number of LCFs is provided in parentheses.

[b] Source: Tables 9, 10, 12, and 13 of this EA.

Beyond activities at LANL, no other activities in the area surrounding LANL are expected to result in radiological impacts on the public beyond those associated with natural background radiation and other background radiation, as discussed in Chapter 4, Section 4.1.1. The projected dose from continued LANL operations is a small fraction of the dose that persons living near LANL receive annually from natural background radiation and other sources, such as diagnostic x-rays.

No LCFs are expected for the MEI or the general population. The dose to the offsite MEI is expected to remain within the 10-millirem-per-year limit required by 40 CFR Part 61, Subpart H, *National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities*. In addition, there would be no appreciable increase in the annual risk of an LCF among the general public from LANL operations.

The 543 person-rem projected dose under the Expanded Operations Alternative in the *LANL SWEIS* (DOE 2008a) corresponds to an annual risk of an LCF in the worker population of 0.3 (or 1 chance of an LCF in the worker population for each 3 years of operation). The addition of impacts from the operation of RLUOB and PF-4 under the alternatives evaluated in this EA would not increase this estimate because a CMRR worker dose of approximately 61 person-rem per year was included in the estimate in the *LANL SWEIS*. Worker doses would decrease by about 140 person-rem per year after MDA remediation work is completed (DOE 2008a). Inclusion of the *SPD Supplemental EIS* (DOE 2015c) and *GTCC LLW EIS* (DOE 2016d) estimates for work at LANL would add about 190 person-rem and 5 person-rem per year, respectively, and would increase the annual risk of an LCF in the worker population by about 0.1. Individual worker doses would be maintained ALARA and within applicable regulatory limits.

The estimated doses shown in Table 28 are a very small fraction of the normal background dose received by the population in and around LANL. Chapter 4, Section 4.1.1, of this EA provides an analysis of radiation in the environment around LANL that is attributed to naturally occurring radiation and radiation from past and present operations at LANL. Natural background radiation was estimated to range from approximately 430 to 570 millirem per year, compared to the total estimated doses from LANL operations of 8.5 millirem per year to the MEI and approximately 0.1 millirem per year to the MEI for the alternatives evaluated in this EA.

Waste Management

Cumulative amounts of waste generated at LANL would be greatest if the Expanded Operations Alternative described in the *LANL SWEIS* were fully implemented. This alternative includes substantial waste generation rates at LANL, largely due to remediation of MDAs and decontamination, decommissioning, and demolition (DD&D) of facilities. The contribution to cumulative waste management impacts from other proposed actions at LANL, particularly overall waste generation at LANL during the next 10 years from disposition of buildings and environmental restoration efforts, could be large. Construction and demolition wastes would be recycled and reused to the extent practicable. Existing waste treatment and disposal facilities would be used according to specific waste types. The estimated waste generation totals for LANL were adjusted for the *CMRR-NF SEIS* (DOE 2011c) to reflect the 2009 cancellation of the Global Nuclear Energy Partnership program, the December 19, 2008 (73 FR 77644), decision not to build a Consolidated Nuclear Facility at LANL, and a reduction in the amount of waste associated with building nuclear weapons pits at LANL; and are further adjusted for this EA to include potential waste from activities evaluated in the *SPD Supplemental EIS* (DOE 2015c). **Table 29** presents the estimated cumulative annual amount of radioactive and nonradioactive waste that could be generated at LANL.

Cumulative TRU waste, LLW, MLLW, and chemical waste generation would be within the levels forecast under the Expanded Operations Alternative described in the *LANL SWEIS*. The available capacity of WIPP is expected to be sufficient to accommodate the estimated cumulative volumes of TRU waste from LANL operations (DOE 2008a). Offsite disposal options for LLW include NNSS and commercial facilities (DOE 2008a). MLLW waste would be sent off site for treatment of the hazardous component and disposal. The alternatives evaluated in this EA would contribute a maximum of 11 percent of the estimated cumulative annual waste generation at LANL.

Cumulative generation of construction and demolition waste would be higher than that under the Expanded Operations Alternative in the *LANL SWEIS* (DOE 2008a) due to the increased waste estimates from the *GTCC LLW EIS* and from DD&D of the existing CMR Building. Significant quantities of nonradioactive solid wastes, including construction and demolition debris, would be generated under the Expanded Operations Alternative if all wastes were removed from MDAs. Demolition of the CMR Building would increase the lower and upper bounds of this estimate, based on the latest projections for the amount of this waste that may be generated during the demolition period. Construction for disposal of GTCC LLW at LANL also could increase generation of solid waste at LANL. Construction and demolition wastes would be recycled and reused to the extent practicable. Debris that cannot be recycled would be disposed of at solid waste landfills or construction and demolition debris landfills. The closure of the Los Alamos County Landfill means that solid wastes would be disposed of via the Los Alamos County Eco Station, where wastes would be segregated and then transported to an appropriately permitted solid waste landfill. The alternatives evaluated in this EA would contribute approximately 1 percent of estimated cumulative annual construction and demolition waste generation.

Table 29. Estimated Annual Cumulative Waste Generated at Los Alamos National Laboratory (cubic yards except where noted)

Waste Type	*LANL Operations* [a]	*Alternatives Evaluated in this EA* [b]	*CMR Building DD&D* [c]	*Revised LANL Operations*
Transuranic	530 to 3,300	88	38 to 75	790 to 1,300
Less Manufacturing of up to 80 Pits	0 to -250	(7 to 11%)		
Less GNEP	0 to -900			
Less Consolidated Nuclear Facility	0 to -1,200			
Less earlier CMR Building Operations Estimate	-90			
Less earlier CMR Building DD&D Estimate	0			
Plus *GTCC LLW EIS* [d]	0			
Plus *SPD Supplemental EIS* [e]	220			
Revised Total	660 to 1,100			
Low-level radioactive	27,700 to 141,400	2,640	9,500 to 19,000	33,000 to 137,000
Less Manufacturing of up to 80 Pits	0 to -410	(2 to 8%)		
Less GNEP	0 to -3,400			
Less Consolidated Nuclear Facility	0 to -12,000			
Less earlier CMR Building Operations Estimate	-2,600			
Less earlier CMR Building DD&D Estimate	-4,000 to -8,000			
Plus *GTCC LLW EIS* [d]	5			
Plus *SPD Supplemental EIS* [e]	380			
Revised Total	21,000 to 115,000			
Mixed low-level radioactive	390 to 18,300	26	70 to 140	430 to 18,300
Less Manufacturing of up to 80 Pits	0	(<1 to 6%)		
Less GNEP	0 to -4			
Less Consolidated Nuclear Facility	0 to -72			
Less earlier CMR Building Operations Estimate	-30			
Less earlier CMR Building DD&D Estimate	-38 to -75			
Plus *GTCC LLW EIS* [d]	0			
Plus *SPD Supplemental EIS* [e]	9			
Revised Total	330 to 18,100			
Chemical Waste (million pounds)	6.4 to 12.9	0.025	0.13	6.6 to 11.8
Less Consolidated Nuclear Facility	0 to -1.4	(<1%)		
Less earlier CMR Building Operations Estimate	-0.025			
Plus *GTCC LLW EIS* [d]	0.05			
Plus *SPD Supplemental EIS* [e]	not provided			
Revised Total	6.4 to 11.5			
Construction and Demolition Waste	64,000 to 72,000	Not applicable	27,500 to 55,000	177,000 to 208,000
Less earlier CMR Building DD&D	-5,000 to -10,000			
Estimate Plus *GTCC LLW EIS* [d]	88,000			
Plus *SPD Supplemental EIS* [e]	negligible			
Revised Total	147,000 to 150,000			

CMR = Chemistry and Metallurgy Research; CMRR-NF = Chemistry and Metallurgy Research Building Replacement Nuclear Facility; DD&D = decontamination, decommissioning, and demolition; GNEP = Global Nuclear Energy Partnership; LLW = low-level radioactive waste.

[a] Data from Table 4–57 of the *CMRR-NF SEIS* (DOE 2011c) except for the *GTCC LLW EIS* (DOE 2016d) and the *SPD Supplemental EIS* (DOE 2015c).

[b] Operational data from Chapter 4, Section 4.3.2.2, of this EA. Under the Proposed Action Alternative, the projected annual quantities of radioactive and chemical wastes during facility modifications would be smaller than the estimated annual quantities during AC and MC operations. The parentheses indicate the percentage of operational waste quantities compared to quantities from revised LANL operations.

[c] Data from Table 4–50 of the *CMRR-NF SEIS* (DOE 2011c). Work to be done over a 2- to 4-year period.

[d] Highest annual data computed from information in Table 5.3.11–1 of the *GTCC LLW EIS* (DOE 2016d).

[e] Highest annual waste generation for construction or operation from Tables 4-15 and 4-19 (DOE 2015c).

Source: DOE 2011c, 2015c, 2016d.

Environmental Justice

Cumulative environmental justice impacts occur when the net effect of regional projects or activities results in disproportionately high and adverse human health or environmental effects on minority or low-income populations. As described in Chapter 4, Section 4.5, there would be no high and adverse effects on any population within the LANL ROI. Impacts on minority or low-income populations would be comparable to those on the population as a whole. Therefore, no cumulative disproportionately high and adverse effects on minority or low-income populations are expected as a result of the small incremental dose resulting from either alternative evaluated in this EA.

In addition, DOE evaluated whether potential impacts on indigenous populations surrounding LANL could be greater than those on the general population as a consequence of their locations near LANL and their cultural affiliation with the natural environment. As described in Chapter 4, Section 4.5, of this EA, DOE performed analyses to examine doses for a hypothetical individual residing at the Pueblo de San Ildefonso and Santa Clara Pueblo boundaries, where the greatest potential impacts on Native Americans are expected. An individual located at either of these pueblos would receive an annual individual dose that would be less than the MEI dose. Thus, there would be no cumulative disproportionately high and adverse effects on these hypothetical individuals.

Furthermore, to assist in identifying the potential impacts from differential patterns of subsistence consumption and cultural practices, this EA references the *LANL SWEIS* (DOE 2008a), for which a number of specific special pathways receptor analyses were performed, including for a hypothetical individual that derived all of his or her food from local sources and also consumed increased amounts of fish, deer, and elk from the areas surrounding LANL and drank surface water and cota (a tea made from local plants). This special pathways receptor would be exposed to additional amounts of contaminated soils and sediments from performing outdoor activities on or near LANL. Such a receptor was estimated to receive an additional dose of up to 4.5 millirem per year from these special pathways (see the *LANL SWEIS*, Section 5.11).

From the 2015 *Los Alamos National Laboratory Annual Site Environmental Report* (LANL 2016c), the dose to a MEI is about 0.13 millirem from site emissions. As described above, the maximum dose to the MEI from the alternatives evaluated in this EA is estimated to be 0.16 millirem per year. Therefore, if the MEI associated with this EA were also assumed to be the LANL site MEI and a special pathways receptor, the maximum dose would be up to 4.8 millirem per year (i.e., up to 4.5 millirem associated with special pathways, 0.13 millirem from other site operations, and up to 0.16 millirem associated with normal operations from AC and MC operations at RLUOB and PF-4). This dose would represent an increase of about 1 percent above the approximately 430 to 570 millirem that a person residing near LANL would normally receive each year from natural background radiation. Although the dose would be higher than that received by an average member of the public in the LANL ROI, it would be well below the annual 100 millirem dose criterion for protection of the public (DOE Order 458.1 [DOE 2011a]) and a small fraction of the background dose received by all persons. In terms of an increased risk of a fatal cancer, the 4.8 millirem per year cumulative special pathways dose would represent an annual estimated risk of 3×10^{-6}, or about 1 chance in 350,000 of an LCF. Therefore, there would be no cumulative disproportionately high and adverse effects on such a receptor.

5.4 Nationwide and Global Cumulative Impacts

This section evaluates cumulative impacts for nationwide radioactive material transportation and global climate change.

Radioactive Material Transportation

The collective doses and cumulative health effects resulting from approximately 130 years (from 1943 to 2073) of radioactive material and waste transport across the United States were estimated in the

SPD Supplemental EIS (DOE 2015c, Table 4–48). As shown in **Table 30**, the total collective worker doses from all types of shipments (including general transportation, historical shipments, reasonably foreseeable actions, and shipments under the *LANL SWEIS* [DOE 2008a]) were estimated to be 422,000 person-rem, which could result in 253 excess LCFs among the worker population. The total collective doses to the general public were estimated to be 437,000 person-rem, which could result in 262 excess LCFs among the general population. The majority of the collective doses for workers and the general population would be associated with general transportation of radioactive materials. Examples of these activities include shipments of radiopharmaceuticals to nuclear medicine laboratories and shipments of commercial LLW to commercial disposal facilities. As shown in Table 30, the estimated doses associated with radioactive waste transportation under the Proposed Action Alternative in this EA (as described in Section 4.4) would be small and would not substantially contribute to cumulative impacts.

Table 30. Potential Cumulative Impacts from Transport of Radioactive Waste

Action		***Crew Dose (person-rem)***	***Crew Risk (LCF)*** [a]	***Population Dose (person-rem)***	***Population Risk (LCF)*** [a]
Other Actions (1943 to 2073) [b]		421,000	253	436,000	262
SPD Supplemental EIS (DOE 2015c)		650	0.4	580	0.3
Draft SSFL Area IV EIS (DOE 2017a)		2	0.001	0.58	0.0003
Alternatives Evaluated in this EA	Facility Modifications [c]	0.54 to 0.68	3×10^{-4} to 4×10^{-4}	0.17 to 0.22	1×10^{-4}
	Operations [d]	125	0.08	41	0.02
Total		422,000	253	437,000	262

EA = environmental assessment; LCF = latent cancer fatality.
[a] Determined using a risk factor of 0.0006 LCF per person-rem (DOE 2003a).
[b] Source: DOE 2015c; includes impacts from the *LANL SWEIS* (DOE 2008a) and *Draft GTCC LLW EIS*. The population dose in the *Final GTCC LLW EIS* (DOE 2016d) is 10 person-rem (0.006 LCF) larger.
[c] Source: Table 21 of this EA.
[d] Source: Table 22 of this EA, assuming 50 years of operations.

Global Climate Change

During 2014, greenhouse gas emissions in the United States totaled about 7,570 billion tons of carbon dioxide equivalent (EPA 2016). As described in Chapter 4, Section 4.11, during the years 2011 through 2014, LANL activities caused an average annual emission of about 63,700 tons of carbon dioxide equivalent. By way of comparison, annual operational emissions of greenhouse gases from the alternatives evaluated in this EA are estimated to be approximately 90 tons of additional carbon dioxide equivalent, which would represent about 0.1 percent of LANL's 5-year average emissions of greenhouse gases from 2011 through 2014, and a very small fraction of U.S. emissions. At present, there is no methodology that would allow DOE to estimate the specific impacts of LANL emissions on climate change..

6.0 REFERENCES

Census (U.S. Census Bureau), 2017a, Cartographic Boundary Shapefiles – Block Groups New Mexico (file cb_2015_35_bg_500k.shp (accessed January 2017, https://www.census.gov/geo/maps-data/data/cbf/cbf_blkgrp.html).

Census (U.S. Census Bureau), 2017b, American FactFinder, B03002 Hispanic or Latin Origin by Race (file *ACS_15_5YR_B03002_with_ann.csv* (accessed January 2017, https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t).

Census (U.S. Census Bureau), 2017c, American FactFinder, C17002 Ratio of Income to Poverty Level in the past 12 Months (file *ACS_15_5YR_B03002_with_ann.csv* (accessed January 2017, https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none).

Census (U.S. Census Bureau), 2017d, American FactFinder, B03002 Hispanic or Latin Origin by Race, County level data (accessed February 2017, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_B03002&prodType=table).

DNFSB (Defense Nuclear Facility Safety Board), 2017, Letter from J. L. Connery, Chairman DNFSB, to The Honorable Ernest J. Moniz, Secretary of Energy, January 3.

DOE (U.S. Department of Energy), 1992, *DOE Standard – Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92, Change Notice No. 1, September 1997, Washington, DC, December.

DOE (U.S. Department of Energy), 1993, *DOE Standard – Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, DOE-STD-1021-93, Reaffirmed with Errata, April 2002, Washington, DC, July.

DOE (U.S. Department of Energy), 1999, *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico*, DOE/EIS-0293, Los Alamos Area Office, Los Alamos, New Mexico, October.

DOE (U.S. Department of Energy), 2002, *DOE Standard – Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, DOE-STD-1020-2002, Washington, DC, January.

DOE (U.S. Department of Energy), 2003a, *Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE), ISCORS Technical Report No. 1*, DOE/EH-412/0015/0802, Rev. 1, Office of Environmental Policy and Guidance, January.

DOE (U.S. Department of Energy), 2003b, *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0350, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, November.

DOE (U.S. Department of Energy), 2004a, *MACCS2 Computer Code Application Guidance for Documented Safety Analysis*, DOE-EH-4.2.1.4-MACCS2-Code Guidance, Washington, DC, June.

DOE (U.S. Department of Energy), 2004b, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements, Second Edison*, Office of NEPA Policy and Compliance, December.

DOE (U.S. Department of Energy), 2005, *Supplement Analysis, Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement (CMRR) Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Changes to the Location of the CMRR Facility Components*, DOE/EIS-0350-SA-01, Los Alamos Site Office, Los Alamos, New Mexico, January.

DOE (U.S. Department of Energy), 2008a, *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0380, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, May.

DOE (U.S. Department of Energy), 2008b, *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement*, DOE/EIS-0236-S4, National Nuclear Security Administration, Washington, DC, October.

DOE (U.S. Department of Energy), 2008c, *DOE Standard – Radiological Control*, DOE-STD-1098-2008, Washington, DC, October.

DOE (U.S. Department of Energy), 2011a, *Radiation Protection of the Public and the Environment*, DOE O 458.1, Admin Change 3 (1-15-13), Office of Health, Safety and Security, Washington, DC, February 11.

DOE (U.S. Department of Energy), 2011b, *Nuclear Material Control and Accountability*, DOE O 474.2, Change 4 (9-13-16), Office of Environment, Health, Safety and Security, Washington, DC, June 27.

DOE (U.S. Department of Energy), 2011c, *Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico*, DOE/EIS-0350-S1, Los Alamos, New Mexico, August.

DOE (U.S. Department of Energy), 2012a, Memorandum, D. L. Cook, National Nuclear Security Administration, Deputy Administrator for Defense Programs, to K. Smith, Manager, Los Alamos Site Office, and C. McMillan, Director, Los Alamos National Laboratory, *Fiscal Year (FY) 2013 Guidance on the Chemistry and Metallurgy Research Replacement Nuclear Facility (CMRR-NF) Project*, February 13.

DOE (U.S. Department of Energy), 2012b, *DOE Standard – Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*, DOE-STD-1020-2012, Washington, DC, December.

DOE (U.S. Department of Energy), 2013a, *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Department of Energy/National Nuclear Security Administration Nevada National Security Site and Off-Site Locations in the State of Nevada*, DOE/EIS-0426, Nevada Site Office, Las Vegas, Nevada, February.

DOE (U.S. Department of Energy), 2013b, *DOE Handbook, Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities,* Volume I and II, DOE-HDBK-3010-94, Reaffirmed 2015, Washington, DC.

DOE (U.S. Department of Energy), 2014, *DOE Standard – Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*, DOE-STD-3009-2014, Washington, DC, November.

DOE (U.S. Department of Energy), 2015a, *Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Supplement Analysis*, DOE/EIS-0350-SA-2, Los Alamos, New Mexico, January.

DOE (U.S. Department of Energy), 2015b, *Department of Energy FY 2016 Congressional Budget Request, National Nuclear Security Administration*, DOE/CF-0107, Volume 1, Washington, DC, February.

DOE (U.S. Department of Energy), 2015c, *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*, DOE/EIS-0283-S2, Office of Fissile Materials Disposition and Office of Environmental Management, Washington, DC, April.

DOE (U.S. Department of Energy), 2015d, *DOE 2014 Occupational Radiation Exposure*, Office of Environment, Health, Safety, and Security, September.

DOE (U.S. Department of Energy), 2016a, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*, Revision 8.0, DOE/WIPP-02-3122, Carlsbad Field Office, Carlsbad, New Mexico, July 5.

DOE (U.S. Department of Energy), 2016b, *Annual Transuranic Waste Inventory Report – 2016*, DOE/TRU-16-3425, Revision 0, Carlsbad Field Office, Carlsbad, New Mexico, December.

DOE (U.S. Department of Energy), 2016c, *DOE 2015 Occupational Radiation Ex*posure, Office of Environment, Health, Safety, and Security, October.

DOE (U.S. Department of Energy), 2016d, *Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste*, DOE/EIS-0375, Office of Environmental Management, Washington, DC, January.

DOE (U.S. Department of Energy), 2017a, *Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory*, DOE/EIS-0402, Office of Environmental Management, Simi Valley, California, January.

DOE (U.S. Department of Energy), 2017b, *DOE 2016 Occupational Radiation Exposure*, Office of Environment, Health, Safety, and Security, November.

Energy*Solutions*, 2016, Letter from V. C. Rogers to S. T. Anderson, Utah Division of Waste Management and Radiation Control, Ground Water Quality Discharge Permit Condition I.H.6 – 2016 Annual As-Built Reports, November 29.

EPA (U.S. Environmental Protection Agency), 1988, *Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, EPA 520/1-88-020 (available at: http://www.epa.gov/rpdweb00/docs/federal/520-1-88-020.pdf), Washington, DC, September.

EPA (U.S. Environmental Protection Agency), 1999a, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, Federal Guidance Report No. 13, EPA 402-R-99-001, September.

EPA (U.S. Environmental Protection Agency), 1999b, *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*, EPA 315-R-99-002, Office of Federal Activities, Washington, DC, May.

EPA (U.S. Environmental Protection Agency), 2016, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2014,* EPA 430-R-16-002, Washington, DC, April 15.

ICRP (International Commission on Radiological Protection), 1991, *1990 Recommendations of the International Commission on Radiological Protection,* ICRP Publication 60, Elmsford, New York.

ICRP (International Commission on Radiological Protection), 2012, *Compendium of Dose Coefficients Based on ICRP Publication 60*, ICRP Publication 119, Pergamon Press.

LANL (Los Alamos National Laboratory), 2004, *Biological Assessment of the Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species*, LA-CP-0-0921, Los Alamos, New Mexico. OUO

LANL (Los Alamos National Laboratory), 2006, *Amended Biological Assessment: The Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species*, LA-CP-06-0020, Los Alamos, New Mexico. OUO

LANL (Los Alamos National Laboratory), 2007, *Amended Biological Assessment: The Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species*, LA-CP-07-0823, Los Alamos, New Mexico. OUO

LANL (Los Alamos National Laboratory), 2009, *Amended Biological Assessment: The Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species*, LA-CP-09-00626, Los Alamos, New Mexico. OUO

LANL (Los Alamos National Laboratory), 2011, *Biological Assessment of the Effects of Proposed Temporary Spoils Storage, Staging, New Parking, and Vehicle Turnaround on Federally Listed Threatened and Endangered Species: The Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species*, LA-CP-11-00306, Los Alamos, New Mexico. OUO

LANL (Los Alamos National Laboratory), 2012, *SWEIS Yearbook 2010, Comparison of 2010 Data to Projections of the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-12-01648, Los Alamos, New Mexico, April.

LANL (Los Alamos National Laboratory), 2013a, *SWEIS Yearbook 2011*, *Comparison of 2011 Data to Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-13-020455, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 2013b, *SWEIS Yearbook 2012*, *Comparison of 2012 Data to Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory*, LA-UR-13-029469, Los Alamos, New Mexico, December.

LANL (Los Alamos National Laboratory), 2014, *Fiscal Year 2015 Site Sustainability Plan*, LA-UR-15-21896, Los Alamos, New Mexico, December 11.

LANL (Los Alamos National Laboratory), 2015, *SWEIS Yearbook 2013*, *Comparison of 2013 Data to Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*, LA-UR-15-22755, Los Alamos, New Mexico, July.

LANL (Los Alamos National Laboratory), 2016a, *Facts*, *Figures for 2016* (accessed October 12, 2016, http://www.lanl.gov/about/facts-figures/index.php).

LANL (Los Alamos National Laboratory), 2016b, *SWEIS Yearbook 2014*, *Comparison of 2014 Data to Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*, LA-UR-16-24711, Los Alamos, New Mexico, July.

LANL (Los Alamos National Laboratory), 2016c, *Los Alamos National Laboratory 2015 Annual Site Environmental Report*, LA-UR-16-26788, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2017, *Los Alamos National Laboratory 2016 Annual Site Environmental Report*, LA-UR-17-27987, Los Alamos, New Mexico, September.

LANL (Los Alamos National Laboratory), 2018, *Response to Data Call for NEPA Environmental Assessment: Proposed Physical and Operational Changes for Analytical Chemistry and Materials Characterization at the Radiological Laboratory Utility Office Building*, Rev. 2, LA-UR-17-24977, Los Alamos, New Mexico, February 5.

NA-LA (National Nuclear Security Administration's Los Alamos Field Office), 2017, NA-LA NEPA Compliance Officer (NCO) Compliance Determination Form LAN No: 18-01, Proposal to conduct mobile-loading operations of transuranic and mixed transuranic waste at Technical Area 55, Los Alamos, New Mexico, October 26.

NCRP (National Council on Radiation Protection and Measurements), 1993, *Risk Estimates for Radiation Protection*, NCRP Report No. 115, Bethesda, Maryland, December 31.

Neuhauser, K. S. and F. L. Kanipe, 2003, *RADTRAN 5 User Guide*, revised by R. F. Weiner, SAND2003-2354, Sandia National Laboratories, Albuquerque, New Mexico, July.

NNSA (National Nuclear Security Administration), 2012, Los Alamos National Laboratory Factsheet.

NNSA (National Nuclear Security Administration), 2014, *Guidance on Using Release Fraction and Modern Dosimetric Information Consistently with DOE STD 1027-92, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports, Change Notice No. 1*, Admin Change 1: 5-13-14, Office of Safety and Health, Washington, DC, November 28.

NNSA (National Nuclear Security Administration), 2016a, *RLUOB Radiological Laboratory Utility Office Building*, Factsheet (accessed October 26, 2016, http://lanl.gov/newsroom/ factsheets/index.php).

NNSA (National Nuclear Security Administration), 2016b, *TA-55 PF-4 LANL Plutonium-Processing Facilities*, Factsheet (accessed October 26, 2016, http://lanl.gov/newsroom/factsheets/index.php).

NRC (U.S. Nuclear Regulatory Commission), 1990, *MELCOR Accident Consequence Code System (MACCS)*, NUREG/CR-4691, Vol. 3, Washington, DC, February.

NRC (U.S. Nuclear Regulatory Commission), 1998, *Code Manual for MACCS2: Volume 1, User's Guide,* NUREG/CR-6613, SAND97-0594, Washington, DC, May.

NRC (U.S. Nuclear Regulatory Commission), 2007, *WinMACCS, a MACCS2 Interface for Calculating Health and Economic Consequences from Accidental Release of Radioactive Materials into the Atmosphere, User's Guide and Reference Manual*, WinMACCS Version 3, August.

SNL (Sandia National Laboratories), 2016, *2015 Annual Site Environmental Report for Sandia National Laboratories, New Mexico*, SAND2016-7275R, Albuquerque, New Mexico, September.

UMTRI (University of Michigan Transportation Research Institute), 2003, *Evaluation of the Motor Carrier Management Information System Crash File, Phase 1*, UMTRI-2003-6, Ann Arbor, Michigan, March.

USFWS (U.S. Fish and Wildlife Service), 2005, Letter from S. MacMullin, USFWS Field Supervisor, to E. Withers, NNSA ESA Program Manager, Re: Biological Assessment of the Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species at Los Alamos National Laboratory, Los Alamos, New Mexico, Consultation #2-22-03-1-0302 dated March 9, 2005, Albuquerque, New Mexico.

USFWS (U.S. Fish and Wildlife Service), 2006, Letter from B. Hanson, USFWS Acting Field Supervisor, to E. Withers, NNSA ESA Program Manager, Re: Amended Biological Assessment: The Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species at Los Alamos National Laboratory, Los Alamos, New Mexico, Consultation #2-22-03-1-0302 dated February 7, 2006, Albuquerque, New Mexico.

USFWS (U.S. Fish and Wildlife Service), 2007, Letter from W. Murphy, USFWS Field Supervisor, to V. Loucks, NNSA Biological Resource Program Manager, Re: Amended Biological Assessment: The Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species at Los Alamos National Laboratory, Los Alamos, New Mexico, Consultation #22420-2007-1-0126 dated September 26, 2007, Albuquerque, New Mexico.

USFWS (U.S. Fish and Wildlife Service), 2009, Letter from W. Murphy, USFWS Field Supervisor, to V. Loucks, NNSA Biological Resource Program Manager, Re: Amended Biological Assessment: The Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species at Los Alamos National Laboratory, Los Alamos, New Mexico, Consultation #22420-09-1-0066 dated August 6, 2009, Albuquerque, New Mexico.

USFWS (U.S. Fish and Wildlife Service), 2011, Letter from W. Murphy, USFWS Field Supervisor, to V. Loucks, NNSA Biological Resource Program Manager, Re: Biological Assessment of the Effects of Proposed Temporary Spoils Storage, Staging, New Parking, and Vehicle Turnaround on Federally Listed Threatened and Endangered Species: The Potential Effects of the Chemistry and Metallurgy Research Facility Replacement Project on Federally Listed Threatened, Endangered, and Sensitive Species at Los Alamos National Laboratory, Los Alamos, New Mexico, Consultation #22420-2011-1-0052 dated May 2, 2011, Albuquerque, New Mexico.

WCS (Waste Control Specialists), 2017, Federal Waste Facility (accessed February 9, 2017, http://www.wcstexas.com/facilities/federal-waste/).

Weiner, R. F., D. Hinojosa, T. J. Heames, C. O. Farnum, and E. A. Kalinina, 2013, *RADTRAN6/RadCat 6 User Guide*, SAND2013-8095, Sandia National Laboratories, Albuquerque, New Mexico, September.

WH (The White House, Office of the Press Secretary), 2014, *Fact Sheet: What Climate Change Means for New Mexico and the Southwest*, Washington, DC, May 6.

Yost, N. R., M. W. Salmon, E. R. MacFarlane, and L. K. Goen, 2016, *Results of RLUOB Seismic Study – With Updated Conclusions*, LA-UR-16-28686, Los Alamos National Laboratory, Los Alamos, New Mexico, November.

Yuan, Y. C., S. Y. Chen, B. M. Biwer, and D. J. LePoire, 1995, *RISKIND – A Computer Program for Calculating Radiological Consequences and Health Risks from Transportation of Spent Nuclear Fuel*, ANL/EAD-1, Argonne National Laboratory, Argonne, Illinois, November.

APPENDIX A
EVALUATION OF HUMAN HEALTH EFFECTS FROM FACILITY ACCIDENTS

Appendix A of this draft environmental assessment (EA) presents an evaluation of the potential impacts on human health from postulated accidents associated with the activities performed in support of analytical chemistry (AC) and materials characterization (MC) operations at Los Alamos National Laboratory (LANL). AC and MC operations under the Proposed and No Action Alternatives evaluated in this Draft EA take place in the Radiological Laboratory/Utility/Office Building (RLUOB) and Plutonium Facility, Building 4 (PF-4) in Technical Area (TA)-55.

Section A.1 presents the methodology used to evaluate potential impacts from potential accidents at RLUOB and PF-4. Section A.2 describes the detailed scenarios, source terms, and impacts from the accidents evaluated for RLUOB. Section A.3 presents the potential impacts of a major site-wide earthquake, a large explosion, or other potential accidents affecting PF-4. Section A.4 presents combined impacts should both facilities be affected.

A.1 Impact Assessment Methods for Facility Accidents

A.1.1 Introduction

Potential accidents are defined in existing facility documentation such as safety analysis reports, documented safety analyses (DSAs), hazards assessment documents, and National Environmental Policy Act (NEPA) documents. The accidents include radiological and chemical accidents that have a low frequency of occurrence but large consequences, as well as a spectrum of other accidents that have a higher frequency of occurrence but smaller consequences. The data in these documents include accident scenarios, the material-at-risk (MAR), source terms (quantities of hazardous materials available for release to workers, the public, or the environment), and consequences.

In determining the potential for facility accidents and their impacts, and presenting the magnitude of the consequences should they occur, this Draft EA considers two important concepts in the presentation of results: (1) risk, and (2) uncertainty and conservatism. Risk is addressed below; uncertainty and conservatism are addressed in Section A.1.7.

One metric that can be obtained from the radiological accident analysis is the dose to an individual or the population. Another metric that can be obtained is accident risk. Risk is usually defined as the product of the consequence and estimated frequency of a given accident. Accident consequences may be presented in terms of dose (for example, person-rem) or health effects (for example, latent cancer fatalities [LCFs]). The accident frequency is the number of times the accident is estimated to occur over a given period of time (for example, in a year). Potential higher-consequence design-basis and beyond-design-basis accidents are not expected to occur over the life of a facility, and their frequency is typically much less than 1 in 100 per year of operation.

A number of specific types of radiological accident risk can be directly calculated from the results of the MACCS2 [MELCOR Accident Consequence Code System] computer code (NRC 1990, 1998) and are reported in this Draft EA. A common set of dose factors, consistent with application of DOE-STD-1027-92 (DOE 1992), are used for all alternatives to evaluate the relative impacts from the different alternatives. The population risk is the product of the accident frequency and the total consequences projected to be experienced by the population. For example, if an accident has a frequency of 0.001 (or 1×10^{-3}) per year and the consequence of the accident is 5 LCFs, then the annual risk of a single LCF in the population is $0.001\times5 = 0.005$. Population risk is a measure of the expected number of LCFs experienced by the population as a whole over the course of a year. In a similar manner, if an accident has a frequency of 0.001 and the consequence of the accident to an individual is an increased risk of an LCF of 0.01, then the annual risk of an LCF is 0.001×0.01 = 0.00001 (or 1 chance in 100,000 of an LCF).

A.1.2 Identification of Material Potentially Released to the Environment

The amount and particle size distribution of material aerosolized in an accident generally depends on the form of that material, the degree and robustness of containment, and the energetics of the potential accident scenario. Once the material is aerosolized, it must still travel through building confinement and filtration systems or bypass the systems before being released to the environment.

A standard DOE formula was used to estimate the source term for each accident at each of the proposed surplus plutonium facilities:

$$\text{Source Term} = \text{MAR} \times \text{DR} \times \text{ARF} \times \text{RF} \times \text{LPF}$$

where:

MAR = material-at-risk (curies or grams)
DR = damage ratio
ARF = airborne release fraction
RF = respirable fraction[35]
LPF = leak path factor

The MAR is the amount of radionuclides (in curies of radioactivity or grams of each radionuclide) available for release when acted upon by a given physical stress or accident. The MAR is specific to a given process in the facility of interest. It is not necessarily the total quantity of material present; rather, it is that amount of material in the scenario of interest postulated to be available for release.

The damage ratio (DR) is the fraction of MAR exposed to the effects of the energy, force, or stress generated by the postulated event. For the accident scenarios discussed in this analysis, the value of the DR varies depending on the details of the accident scenario, but can range up to 1.0.

The airborne release fraction (ARF) is the fraction of material that becomes airborne due to the accident. The respirable fraction (RF) is the fraction of the material with a particulate aerodynamic diameter less than or equal to 10 microns (0.0004 inches) that could be retained in the respiratory system following inhalation. The value of each of these factors depends on the details of the specific accident scenario postulated. ARFs and RFs were estimated according to reference material in *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, DOE-HDBK-3010 (originally issued in 1994 and reaffirmed in 2013 [DOE 2013b]).

The leak path factor (LPF) accounts for the action of removal mechanisms (e.g., containment systems, filtration, and deposition) to reduce the amount of airborne radioactivity ultimately released to occupied spaces in the facility or the environment.

No accident scenarios were identified that would result in a substantial release of plutonium or other radionuclides via liquid pathways.

Consistent with the purposes of NEPA evaluations, the accident assumptions for the EA were based on realistic yet conservative assumptions on what might happen in an accident. Thus real accidents are expected to release even smaller quantities of nuclear materials from the building to the environment. Site safety documents serve a different purpose and generally assume all material, regardless of form, is involved in an accident and all that could become airborne is released from the building. This approach

[35] Respirable fractions are not applied in the assessment of doses based on noninhalation pathways, such as criticality.

allows identification of safety controls, such as strong containers and building confinement systems, including high efficiency (HEPA) filters that would reduce releases from accidents. In this EA, limited credit is taken for the safety systems that would be in place during operations.

A.1.3 Evaluation of Facility Radiological Accident Consequences

Potential Receptors

For each potential accident, information is provided on accident consequences and frequencies for three types of receptors: (1) a noninvolved worker, (2) the maximally exposed member of the public, and (3) the offsite population. The first receptor, a noninvolved worker, is a hypothetical individual working on site, but not involved in the proposed activity. For purposes of this Draft EA, the noninvolved worker was conservatively assumed to be exposed to the full release, without any protection, located at a distance of about 240 yards from the release point in TA-55. Such a person was assumed to be unaware of the accident, and so be unaware of the emergency actions needed for protection, and to remain in the plume for the entire passage. Workers within the area where the accident occur would be trained to respond to an emergency and are expected to take proper actions to limit their exposure to a radioactive plume. If they failed to take proper actions, they could receive higher doses. For the accidents addressed in this Draft EA, accidental releases would be either at ground level, building roofs, or through low-to medium-stacks for all design-basis accidents. In contrast to the NEPA approach of a realistic analysis of the impacts to a noninvolved or collocated worker, DOE safety requirements specify a bounding impact analysis (without safety controls) be performed for a hypothetical noninvolved or collocated worker at 100 meters (~109 yards) downwind and safety controls be added, if necessary, to protect the worker.

The second receptor, a maximally exposed member of the public (MEI), is a hypothetical individual assumed to be at a location along the site boundary (typically the LANL boundary) where he or she would receive the largest dose. Exposures received by this individual are intended to represent the highest doses to a member of the public. The third receptor, the offsite population, comprises all members of the public within 50 miles of the accident location.

Consequences for workers directly involved in the processes under consideration are addressed generically, without attempt at a scenario-specific quantification of consequences. The uncertainties involved in quantifying accident consequences become overwhelming for most radiological accidents due to the high sensitivity of dose values to assumptions about the details of the release and the location and behavior of the affected worker. Consequences for potential receptors as a result of plume passage were determined without regard for emergency response measures and, thus, are more conservative than are expected if evacuation and sheltering were explicitly modeled. Instead, it was assumed that potential receptors would be fully exposed in fixed positions for the duration of plume passage, thereby maximizing their exposure to the plume. A conservative estimate of total consequences was obtained by assuming all released radionuclides contributed to the inhalation dose as opposed to removal of some of them from the plume by surface deposition; surface deposition is a less significant contributor to overall risk and is controllable through interdiction.

For the public, the MEI, and a noninvolved worker, there are no established radiological standards for doses associated with an accident. DOE uses an individual dose of 25 rem in its safety analysis as an evaluation guideline as to whether safety class or safety significant controls are required.

Population Distributions

Population distributions used in the impact assessments were based on the most recently available U.S. census information (the 2015 U.S. census). These values were extrapolated to a representative year of projected operations (2030), based on estimated population growth rates in the LANL vicinity. Population distributions were spatially distributed on a circular grid with 16 directions and 10 radial distances out to 50 miles. Grids were positioned at centralized locations from which the preponderance of radionuclides would be released in the event of an accident. **Table A–1** presents the results of this effort for the 50-mile population from RLUOB.

Table A–1. Projected Radial 2030 Population Distribution from RLUOB

	Radial Distance from Release Point (miles)										Population
Direction	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**1-50**
E	0	0	123	152	31	268	8,081	1,940	1,359	1,238	13,192
ENE	0	41	823	472	42	367	20,283	4,385	2,064	7,030	35,507
ESE	0	15	16	23	31	401	3,351	2,339	547	1,361	8,084
N	6	691	1,730	104	90	246	222	325	226	191	3,831
NE	6	299	829	91	97	547	3,294	5,768	1,312	294	12,537
NNE	6	864	725	77	96	411	693	1,099	445	239	4,655
NNW	6	109	815	316	93	425	114	135	153	190	2,356
NW	0	22	87	130	163	311	210	186	713	268	2,090
S	0	0	0	40	55	158	1,084	1,543	1,340	1,999	6,219
SE	0	0	25	33	44	5,054	2,420	69,323	3,662	2,707	83,268
SSE	0	0	0	0	0	443	2,103	57,613	8,317	906	69,382
SSW	0	0	30	59	15	41	908	5,377	7,957	50,927	65,314
SW	0	0	34	62	16	41	320	1,154	16,735	162,354	180,716
W	0	0	30	116	164	196	226	404	542	399	2,077
WNW	0	0	40	131	168	168	242	364	731	554	2,398
WSW	0	0	29	58	77	136	170	1,339	1,872	1,963	5,644
Total Population	24	2,041	5,336	1,864	1,182	9,213	43,721	153,294	47,975	232,620	497,270

Notes: The population within 50 miles of RLUOB was projected to a 2030 population estimate of 497,270. The population within a 50-mile radius determined from U.S. Census data for 2015 (Census 2017a) was projected to 2030 based on the trends in the populations in the counties within the 50-mile radius.
Distances are in miles. The listed populations are the estimated number of individuals within the population radial directions and distance segments.

A.1.4 Modeling of Dispersion of Releases to the Environment

The MACCS2 computer code (version 1.13.1) was used to estimate the radiological consequences of accidents for the proposed facilities. The WinMAACCS2 interface (NRC 2007) was used as an input tool for MACCS2. A detailed description of the MACCS2 model is available in U.S. Nuclear Regulatory Commission documents NUREG/CR-4691 (NRC 1990) and NUREG/CR-6613 (NRC 1998). Originally developed to model the radiological consequences of nuclear reactor accidents, this code has been used for the analysis of accidents in many environmental impact statements (EISs) and other safety documentation and is considered applicable to the analysis of accidents associated with the disposition of plutonium.

MACCS2 models the offsite consequences of an accident that releases a plume of radioactive materials into the atmosphere — specifically, the degree of dispersion versus distance as a function of historical wind direction, speed, and atmospheric conditions. Were such an accidental release to occur, the radioactive gases and aerosols in the plume would be transported by the prevailing wind and dispersed in the atmosphere, and the population would be exposed to radiation. MACCS2 generates the distribution of downwind doses at specified distances, as well as the distribution of population doses out to 50 miles.

Because the purposes of the NEPA analyses and DOE safety-basis analyses differ, the assumptions and techniques used for modeling dispersion of releases to the environment with the MACCS2 model in this EA are similar to, yet in some cases different from, those used by DOE for safety-basis analyses. The goal of the NEPA analyses is to present realistic but conservative estimates of the potential impacts of accidents, while the goal of the safety-basis analyses is to present bounding estimates of potential impacts and identify safety controls to prevent or mitigate those accidents.

MACCS2 was run with meteorological data for the years 2011 through 2015 for several release points corresponding to the major radiological accidents evaluated. The results for the 5 calendar years were reviewed and the year with the highest offsite consequences was used to project the impacts.

Radiological doses were calculated that would result from the inhalation of one gram of plutonium aerosol particles by using the 50-year committed inhalation dose coefficients for adults that are presented in International Commission on Radiation Protection (ICRP) Publication 119 (ICRP 2012) and the U.S. Environmental Protection Agency (EPA) Federal Guidance Report (FGR) 13 (EPA 1999a). The dose coefficients in ICRP Publication 119 are for three broad categories of aerosol particle absorption rates in the human respiratory tract, namely fast (F), medium (M) and slow (S). These categories correspond roughly to the lung clearance classes in EPA's FGR 11 (EPA 1988): D, W, and Y respectively. Category S is assigned to materials that are less soluble in water, and aerosol plutonium particles produced by metal fires or from mechanical impact on finely divided oxide powders fall into this category. So do aerosol particles generated from plutonium metal by mechanical means because plutonium is pyrophoric and respirable aerosol particles of plutonium are consequently rapidly oxidized.

The MACCS2 dose library based on FGR 13 (EPA 1999a) inhalation dose conversion factors was used for this Draft EA. For exposure to plutonium oxides and aerosols from metal, the dominant pathway for exposure is inhalation of very small, respirable particles. For accidents involving release of plutonium, the more-recent dose conversion factors, based on FGR 13 (EPA 1999a), would result in estimated doses of about 19 percent of the values reported in many earlier DOE EISs, which typically used dose conversion factors from the older FGR 11 (EPA 1988) lung models. Overall, the values reported in this Draft EA are both conservative and internally consistent. The uncertainties in the estimated source terms far outweigh the differences in the modeling and dose conversion factor models that are used in this Draft EA.

As implemented in this Draft EA, the MACCS2 model evaluates doses due to inhalation of aerosols such as respirable plutonium, as well as exposure to the passing plume. This represents the major portion of the dose that a noninvolved worker or member of the public would receive as a result of a facility accident involving plutonium. The longer-term effects of plutonium deposited on the ground and surface waters after the accident, including effects through resuspension and inhalation of plutonium and ingestion of contaminated crops, were not modeled for accidents in this Draft EA. These pathways have been studied and found not to contribute as significantly to dosage as inhalation, and they are controllable through interdiction. Instead, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces remains airborne and available for inhalation. This adds conservatism to inhalation doses that can become considerable at large distances (as much as two orders of magnitude of conservatism at the 50-mile limit). Thus, the method used in this Draft EA is conservative compared with the dose results that would be obtained if deposition and resuspension were taken into account.

The region around the facility is divided by a polar-coordinate grid centered on the facility itself. The user specifies the number of radial divisions and their endpoint distances. The angular divisions used to define the spatial grid correspond to the 16 directions of the compass.

Dose distributions were calculated in a probabilistic manner. Releases during each of the 8,760 hours of the year were simulated, resulting in a distribution of dose reflecting variations in weather conditions at the time of the postulated accidental release. The code outputs the conditional probability of exceeding an individual or population dose as a function of distance. As is typical for DOE NEPA documents, the reported doses in this Draft EA are the mean or average dose based on the range of weather or meteorological conditions at LANL. Safety basis documents often use 95th percentile doses, which imply that only 5 percent of the weather conditions would result in higher doses. The MACCS2 analysis for this Draft EA indicated that 95th percentile doses are about a factor of 3 higher for the 50-mile population, and about a factor of 7 higher for the offsite individual doses reported in this Draft EA.

MACCS2 cannot be used to directly calculate the distribution of maximum doses (resulting from meteorological variations) around irregular contours, such as a site boundary. As a result, analyses that use MACCS2 to calculate site boundary doses usually default to calculating doses at the distance corresponding to the shortest distance to the site boundary. In effect, the site boundary is treated as if it were circular, with a radius equal to the shortest distance from the facility to the actual site boundary. While this approximation is conservative with respect to dose (with the possible exception of doses from elevated plumes), it eliminates the use of some site-specific information, namely the site boundary location (other than the nearest point), wind direction, and any correlation between wind direction and other meteorological parameters. Because the primary purpose of this Draft EA is to aid in a decision between the evaluated alternatives, a different approach was taken to more-accurately characterize the potential for maximum doses at the site boundary.

For this Draft EA, the individual doses reported are for the wind direction with the highest consequences. This approach would be quite conservative if applied in some directions where the wind blows infrequently, but would be generally the most useful when receptors in multiple directions may be of interest.

For this Draft EA, a duration of 10 minutes was assumed for all RLUOB and PF-4 facility accident releases. This is consistent with the accident phenomenology expected for all scenarios, with the possible exception of fire. Depending on the circumstances, the time between fire ignition and extinction may be considerably longer, particularly for larger beyond-design-basis fires. However, even in a fire of long duration, it is possible to release substantial fractions of the total radiological source term in fairly short periods as the fire consumes areas of high MAR concentrations. The assumption of a 10-minute release duration for fire is intended to generically account for this circumstance

As implemented in this Draft EA, the MACCS2 model evaluates doses due to inhalation of aerosols such as respirable plutonium, as well as exposure to the passing plume. This represents the major portion of the dose that a noninvolved worker or member of the public would receive as a result of an accident. The longer-term effects of plutonium deposited on the ground and surface waters after the accident, including through resuspension and resulting inhalation of plutonium and ingestion of contaminated crops, were not modeled. These pathways would not contribute as significantly to the inhalation dose because access to impacted areas and ingestion of contaminated foods would be controllable through interdiction. Modeling parameters selected for input to the MACCS2 model were either default parameters or were parameters selected because they were known to be conservative. While other parameters might be selected, sensitivity analyses have demonstrated that the combined effect of the selected modeling parameters is conservative.

A.1.5 Evaluation of the Consequences of Releases to the Environment

The probability coefficients for determining the likelihood of fatal cancer, given a dose, are taken from the *1990 Recommendations of the International Commission on Radiological Protection* (ICRP 1991) and DOE guidance (DOE 2004a). For low doses or low dose rates, probability coefficients of 6.0×10^{-4} fatal cancers per rem and person-rem are applied for both workers and the general public (DOE 2003a). For cases where the individual dose would be equal to or greater than 20 rems, the LCF risk was doubled (NCRP 1993).

A.1.6 Frequency of Occurrence Estimates

Existing safety documents for PF-4 and RLUOB facilities do not include estimates of frequencies for all scenarios. In many instances, frequencies are discussed qualitatively; quantitative estimates are not developed. For some types of accidents, the bases for frequency estimates varied from facility to facility or used data that were not current. It was necessary, therefore, to evaluate existing estimates of accident scenario frequencies to ensure the frequency estimates are consistent and reasonable.

Quantitative estimates were generally used in this Draft EA when they were provided in an existing safety document. A qualitative frequency category, or bin, often was selected based on the description of the scenario in the safety document. Frequency categories recommended in DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis* (DOE 2014), were used. Accident frequencies are generally grouped into the bins of "anticipated," "unlikely," "extremely unlikely," and "beyond extremely unlikely," with estimated frequencies of greater than 1×10^{-2}, 1×10^{-2} to 1×10^{-4}, 1×10^{-4} to 1×10^{-6}, and less than 1×10^{-6} per year, respectively. The evaluated accidents represent a spectrum of accident frequencies and consequences ranging from low-frequency/high-consequence to high-frequency/low-consequence events.

When a new accident scenario was postulated for this Draft EA, judgment was used to estimate the frequency category of the accident scenario. The frequency estimates are based on assessment of the likelihood of the initiating event and the number and potential effectiveness (availability) of the preventive and existing mitigative controls that must fail in order for the scenario to occur. Quantitative evaluations (such as event or fault tree analyses) were not performed.

A.1.7 Uncertainties and Conservatism

The analyses of accidents are based on calculations relevant to hypothetical sequences of events and models of their effects. The models provide estimates of the frequencies, source terms, pathways for dispersion, exposures, and effects on human health that are as realistic as possible within the scope of the analysis. In many cases, minimal experience with the postulated accidents leads to uncertainty in the calculation of their consequences and frequencies. This fact has prompted the use of models or input values that yield conservative estimates of consequence and frequency. All alternatives have been evaluated using uniform methods and data to allow a fair comparison.

A.2 Development of RLUOB Accident Scenarios for the Proposed Action and No Action Alternatives

Potential accidents associated with operations at PF-4, RLUOB, and support facilities have been extensively evaluated in existing NEPA documents and safety analyses supporting the operation of those facilities. These NEPA documents include the *CMRR EIS* (DOE 2003b), *LANL SWEIS* (DOE 2008a), *CMRR-NF SEIS* (DOE 2011c), *2015 CMRR SA* (DOE 2015a), and *SPD Supplemental EIS* (DOE 2015c). These facilities maintain safety basis documents that evaluate the hazards associated with operations and identify controls to provide reasonable assurance of adequate protection of workers, the public, and the environment, taking into account the work to be performed and the associated hazards (10 *Code of Federal Regulations* [CFR] 830.4[c]). In addition, the *Response to Data Call for NEPA Environmental Assessment: Proposed Physical and Operational Changes for Analytical Chemistry and Materials Characterization at the Radiological Laboratory Utility Office Building* (*LANL Data Call Response*) (LANL 2018) reviews the range of potential nuclear and chemical hazards in RLUOB and identified bounding accident scenarios based on the existing safety documents for RLUOB and the Chemistry and Metallurgy Research (CMR) Building.

For this Draft EA, the proposed operations at affected facilities were reviewed to determine whether the new operations would result in substantial changes to the accident risks identified in safety basis documents and previous NEPA analyses. The NEPA documents cited above evaluate a range of accidents including operational accidents such as spills, fires, and explosions; accidents initiated by external events such as wildfires and aircraft crashes; and natural phenomena-initiated events such as earthquakes. The operations associated with the proposed activities at PF-4 and RLUOB are similar to those identified in the current NEPA documents supporting those facilities, including the *2015 CMRR SA* which evaluated using RLUOB as a Radiological Laboratory with a plutonium-239 equivalent (PuE)[36] limit of up to 38.6 grams (i.e., the current No Action Alternative); the *LANL SWEIS* and the *SPD Supplemental EIS* for PF-4; the *CMRR EIS;* the *CMRR-NF SEIS* (DOE 2011c) for RLUOB; and the *LANL SWEIS* for support facilities including waste management capabilities in TA-50 and TA-54. The proposed changes evaluated in this Draft EA do not introduce new types of hazards or larger quantities of radionuclides compared to those identified in these existing EISs and the accident risks are expected to be well within the accident risks reported in them. In some cases, the amounts of radionuclides in gloveboxes and rooms would decrease substantially from the quantities assumed in the existing NEPA documents. From an accident risk and impact perspective, the principal difference between the No Action Alternative evaluated in the *2015 CMRR SA* and the Proposed Action Alternative is raising the RLUOB inventory limit to 400 grams PuE. No new accident scenarios have been identified during tours of RLUOB, reviews of existing NEPA documents, or reviews of the ongoing LANL safety reviews of the Proposed Action in RLUOB and the exiting safety basis documents for PF-4.

The following subsections identify how the proposed changes in operations at PF-4 and RLUOB would affect accident risks in those facilities. The subsections also evaluate the extent to which the accident risks reported in the existing NEPA documents bound the incremental risks associated with the proposed changes in operations. Radioactive doses and risks are evaluated for noninvolved workers, the offsite population, and an MEI. After addressing accident risks separately for PF-4 and RLUOB, the appendix addresses the implications for accident risks considering the combination of nuclear facilities in TA-55, the CMR in TA-3, and waste management activities in TA-54.

A.2.1 Hazard Identification and Material-at-Risk for RLUOB

The *LANL Data Call Response* (LANL 2018) reviews the potential nuclear and chemical hazards at RLUOB associated with ongoing operations as a Radiological Laboratory (the No Action Alternative) and operations as a Hazard Category 3 Nuclear Facility with a 400-gram PuE building inventory limit (the Proposed Action Alternative). **Table A–2** presents a summary of nuclear hazards identified for RLUOB based primarily on the existing DSAs and the *LANL Data Call Response* (LANL 2018), adjusted for the increased material-at-risk limit of 400 grams PuE under the Proposed Action Alternative.

The *LANL Data Call Response* (LANL 2018) indicates that while RLUOB currently operates as a less than Hazard Category 3 Nuclear Facility, the amounts of radiological material inside the gloveboxes range in size from milligram to near gram quantities. Some areas outside of the gloveboxes are used to store radiological material in anticipation of analysis or waste discard. Under the Proposed Action Alternative, RLUOB would operate as a Hazard Category 3 Nuclear Facility but many of the gloveboxes would still contain radiological material in the same milligram to near gram quantities, except there would be more of these gloveboxes. Also, some of the gloveboxes would contain tens of grams of material though the majority of the material in these quantities would be in a metal form. Small amounts of oxide and residual amounts in solution would be present. During normal, abnormal, and accident conditions, the facility worker would be subject to radiological consequences that are comparable to what the facility worker experiences within RLUOB as a less than Hazard Category 3 Nuclear Facility.

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[36] For some facilities, the exact quantities of MAR, as well as the isotopic composition of some forms of plutonium, are sensitive from a security perspective. Many safety analyses have adopted the strategy of using a convenient surrogate, plutonium-239 equivalents, for the actual quantities, forms, and isotopic composition of the materials. PuE refers to quantities of different radionuclides on a common health-risk basis. The mass or radioactivity of other radionuclides is expressed in terms of the amount of plutonium-239 that would result in the same committed effective dose upon inhalation.

Table A–2. Summary of Nuclear Hazards

Hazard Description	*Amount/Units*	*Form*
PuE MAR limit for facility	400 grams PuE total	Oxides, solutions, metals, powders, salts
Fissile Limit [a]	400 grams of Pu-239 500 grams of U-233 700 grams of U-235	Any form
Breakdown of Hazards		
PuBe	< 5 grams and < 10 mR/h	Powder, metals
Am-241	< 1 gram and < 50 mR/h	Solution, powder
Tritium contaminated parts or small samples	< 1 gram tritium	Adhered to parts or small amounts of gas
U-233	Small gram quantities per process location are typical, and 2-liter containers per process location; less than the fissile limit of 500 grams	Oxides, liquids, metals, powders, salts, residue solutions
U-235	Up to 700 grams in solid, and small-gram quantities in liquid per process location; not to exceed fissile limit of 700 grams.	Oxides, liquids, metals, powders, salts, residue solutions
U-238	Up to several hundred grams in solid, and small-gram quantities in liquid per process location.	Oxides, liquids, metals, powders, salts, residue solutions
Np-237	Small-gram quantities per process location, and 2-liter containers per process location.	Oxides, liquids, metals, powders, salts, residue solutions
Pu (mainly weapons grade and may include other Pu material types)	Small gram quantities per process location, and 2-liter containers per process location.	Oxides, liquids, metals, powders, salts, residue solutions

Am = americium; MAR = material-at-risk; mR/h = millirad per hour; Np = neptunium; Pu = plutonium; PuBe = plutonium/beryllium; PuE = plutonium-239 equivalent; U = uranium.

[a] Per the LANL Criticality Safety Program, Pu-239/U-235/U-233 with combined mass of 450 grams will require a criticality safety evaluation (LANL 2018).

Source: LANL 2018.

The chemical inventory and the projected impacts to a collocated worker at 100 meters and a member of the public at 1,000 meters as a fraction of the DOE protective action criteria (PAC) are presented in the *LANL Data Call Response* (LANL 2018). For convenience, the largest chemical hazards (greater than 10 percent of PAC) are summarized in **Table A–3,** showing that currently no chemical inventory exceeds the PAC for either the collocated worker or the public. Thus, the chemical hazard is classified as low. LANL expects that the need for more chemicals would be limited to the potential need for hydrochloric acid in addition to the current facility inventory limit of 50 pounds. LANL expects that any revisions to this summary as a result of revisions to the predicted annual facility inventory or presence of new chemicals would be reflected in the Preliminary DSA if the Proposed Action Alternative is adopted (LANL 2018). Possible revisions should not exceed protective action criteria levels warranting controls given the proposed AC and MC operations.

Chemical exposures from actual handling by the facility workers are considered Standard Industrial Hazards per the guidance in DOE-STD-3009-2014, Section A.2 (DOE 2014). This would be elaborated upon in the Preliminary DSA if the Proposed Action Alternative is adopted (LANL 2018). Because the chemical hazards to workers are consider standard industrial hazards and the risks to the public have been shown to be fractions of the PAC-2 levels, chemical hazards will not be evaluated further in this Draft EA.

Table A–3. Summary of Chemical Hazards

Chemical	*Predicted Annual Facility Inventory (pounds)*	*Noninvolved (collocated) Worker Impact Assessment at 100 meters*		*Public Impact Assessment at 1 Kilometer*	
		PAC-3 Limit (pounds)	*Fraction of PAC-3 Limit*	*PAC-2 Limit (pounds)*	*Fraction of PAC-2 Limit*
Ammonium hydroxide (as NH_3)	20	185	0.108	849	0.0235
Argon	41,100	1.01×10^5	0.405	1.85×10^6	0.0222
Bromine	20	48.5	0.412	43.8	0.457
Carbon monoxide	50	58.5	0.855	470	0.106
Hydrochloric acid	50	54.9	0.911	3,870	12.9
Hydrogen bromide (Hydrobromic acid)	15	61.2	0.245	408	0.0367
Hydrogen fluoride (Hydrofluoric acid)	50	335	0.149	5,840	8.57×10^{-3}
Mesitylene (1, 3, 5-Trimethyl benzene)	20	155	0.129	4,960	4.03×10^{-3}
Nitric acid (> 94.5)	500	803	0.623	6.70×10^3	0.0746
Nitric oxide	3	3.79	0.792	72.6	0.0413
Nitrogen (cyrogenic)	16,000	1.54×10^5	0.104	4.73×10^6	9.73×10^{-4}
Nitrogen dioxide	5	5.82	0.859	112	0.0448
Sodium hydroxide	100	773	0.129	2.47×10^4	4.05×10^{-3}

PAC = protective action criteria.
Source: LANL 2018.

A.2.2 Accident Scenario Identification for RLUOB

The potential nuclear accident scenarios at RLUOB associated with a 400-gram PuE building inventory limit for the Proposed Action Alternative were reviewed based on past accident evaluations. The analytical chemistry and material characterization processes in the recategorized (400-gram PuE) RLUOB are similar to those that currently occur in the CMR facility, Wings 5 and 7, except that the MAR limits are 4,000 grams PuE in each Wing. The overall CMR facility limit is even greater (9,000 grams PuE).

The hazards identified for RLUOB reconfigured as a MAR-limited Hazard Category 3 Nuclear Facility are:

- Fires within the building, a room, or a glovebox
- Explosions due to overpressurizations
- Loss of confinement due to a spill within laboratories or impact during operations
- Direct exposure
- Criticality
- External events (including man-made events) including natural gas explosion, wildland fire, airplane crash, or vehicle impact
- Natural phenomenon, including high wind, earthquake, and lightning strike

Criticality is precluded by the total material limit in the reconfigured RLUOB of 400 grams PuE, which is below the theoretical value for criticality for plutonium set at 450 grams by the U.S. Nuclear Regulatory Commission in 10 CFR Part 70.[37] A limit (or other appropriate controls) on total fissile gram equivalent to accommodate expected small-scale, highly enriched uranium operations and ensure criticality safety will be required if the 400 gram PuE quantity is exceeded. Also, combinations of plutonium-239, uranium-233, and uranium-235 will require evaluation (LANL 2018).

The *LANL Data Call Response* identifies a building MAR limit of 400 grams PuE as a specific administrative control expected for the proposed reconfigured RLUOB. This value is the basis for impacts analyses presented in this EA. For the purpose of mitigating doses to facility workers in the event of an accident, the *LANL Data Call Response* (LANL 2018) also proposes a laboratory room MAR limit of 100 g PuE.

The current RLUOB hazards analysis report for RLUOB categorized as a Radiological Laboratory identifies a range of controls to prevent or mitigate the postulated accidents, including: glovebox or hood; glovebox heat detection; facility ventilation systems; air monitors; fire suppression system; fire detection and paging system; fire barriers; and limits on combustibles.

Table A–4 lists the safety controls that are currently available in RLUOB and are planned for selection as Other Equipment Important to Safety in the Preliminary DSA as a function of accident type (LANL 2018).

Table A–4. RLUOB Equipment Contributing to the Overall Defense-in-Depth

Safety Control	*Fire*	*Explosives*	*Loss of Confinement*	*Direct Exposure*	*External Events*	*Natural Phenomena*
Fire Protection System	X					
Laboratory Enclosure Systems	X	X	X	X	X	X
Ventilation Systems		X	X	X		
Building Structural Design	X				X	X
Lightning Protection System	X					

Source: LANL 2018.

The structure and safety systems at RLUOB are expected to provide substantial barriers to mitigate accidents and minimize the release of hazardous materials to the environment. The *LANL Data Call Response* (LANL 2018) indicates RLUOB's primary structural design requirement is for a DOE Performance Category (PC)-2 compliant design, but most of RLUOB is classified as PC-1. Institutional requirements are compliant with the LANL Engineering Standards Manual PD-342 (see Section 5, Table II-7, of the manual) and the International Building Code (IBC).

A reanalysis of RLUOB has been performed with respect to the current seismic hazard at TA-55 (Yost et al. 2016). Those seismic analyses of RLUOB's structure indicate that the structure will meet the seismic performance goals in DOE-STD-1020-2012, *National Phenomena Hazards Analysis and Design Criteria for DOE Facilities* (DOE 2012b) for Seismic Design Category 1 for Limit State A without any

[37] 10 CFR 70.4 defines a Critical mass of special nuclear material (SNM) to be SNM in a quantity exceeding 700 grams of contained uranium-235; 520 grams of uranium-233; 450 grams of plutonium; 1,500 grams of contained uranium-235, if no uranium enriched to more than 4 percent by weight of uranium-235 is present; 450 grams of any combination thereof; or one-half such quantities if massive moderators or reflectors made of graphite, heavy water, or beryllium may be present.

modification to the structure. The results also show that a majority of elements of the structure meet the performance requirements for Seismic Design Category 2 for Limit State B.[38]

The office portion of RLUOB is classified as IBC Type 1A/International Organization for Standardization Class 6 (Fire Resistive Construction). RLUOB's structure is cast-in-place concrete from the foundation through the first floor. Above that, the structure is steel with lightweight concrete floors over a composite metal deck. Notable structural design features include the use of special steel moment frames above the second floor to resist lateral load, and the use of special concrete shear walls from the basement to the second floor (LANL 2018).

The RLUOB fire protection system is designed to detect and suppress fires. It consists of sensors, sprinkler heads, distribution piping to the sprinklers, and electric fire pumps to provide water to the distribution piping. It also includes a standpipe system to enable fire department personnel to manually suppress any residual elements of a fire that are not completely extinguished by the fire protection system. The sprinkler system includes wet pipe sprinkler systems, dry sidewall sprinklers, and deluge sprinkler systems. Activation of the fire sprinklers automatically activates the fire pumps (activation of a fire sprinkler releases water and lowers the water pressure in the system, which in turn signals the fire pumps to start).

The heating, ventilation, and air conditioning system for the RLUOB radiological laboratory area consists of three levels of confinement barriers, identified as Zone 1, Zone 2, and Zone 3. The flow of air is from areas of lower to higher contamination potential (i.e., Zone 3 to Zone 1). The zones are defined as follows:

> Zone 1 – primary confinement system which includes the glovebox enclosures and associated exhaust systems.
>
> Zone 2 – secondary confinement system which includes the walls, floor, ceiling, and doors of the laboratories, including hoods and open-front enclosures.
>
> Zone 3 – additional confinement barrier which includes the walls, floors, ceilings, and doors of the corridor or space that surrounds the laboratory.

Air from laboratory gloveboxes, vacuum pumps, and the wet vacuum and radioactive liquid waste tanks are exhausted through the Zone 1 exhaust system. Because the Zone 1 exhaust has the most potential for contamination and is a primary containment boundary, the exhaust air passes through a certified high-efficiency particulate air (HEPA) filtration system with fire protection before release to the atmosphere. The Zone 1 exhaust system is mounted in the basement area and exhausts directly to the stack. It consists of two radiological HEPA filter units and two associated centrifugal fans. Zone 2 handles a much larger air volume and exhausts air from laboratory hoods and open-front enclosures, the laboratory room, and laboratory support rooms. The Zone 2 exhaust system also is mounted in the basement area and comprises a certified HEPA filtration system with fire protection that exhausts directly to the stack. It consists of six radiological HEPA filter units and six associated centrifugal fans. Stack emissions are monitored to record radiation releases, if any, and to provide data for regulatory compliance determinations. The Zone 3 system provides makeup air to Zone 2 and runs at a negative pressure

[38] A seismic design category (SDC) is a category assigned to a structure, system or component (SSC) that is a function of the severity of adverse radiological and toxicological effects of the hazards that may result from the seismic failure of the SSC on workers, the public, and the environment. SSCs may be assigned to SDCs that range from 1 through 5. For example, a conventional building whose failure may not result in any radiological or toxicological consequences is assigned to SDC-1; a safety-related SSC in a nuclear material processing facility with a large inventory of radioactive material may be placed in SDC-5. A limit state is the limiting acceptable deformation, displacement, or stress that a SSC may experience during, or following, an earthquake and still perform its safety function. Four limit states are identified in DOE-STD-1020-2012 (DOE 2012b).

relative to the outside air and a positive pressure relative to Zone 2 to ensure contamination control. Supply air to the laboratories is filtered and humidity-controlled.

A.2.3 Selection and Source Term Evaluation of Representative Accident Scenarios

Based on the review of the various NEPA documents and the *LANL Data Call Response*, the following accidents were selected for evaluation in this Draft EA. These accidents are expected to represent all accidents that might occur in RLUOB with either the 38.6-gram or 400-gram PuE building inventory limit.

*Process or Facility-Wide Spill***—**All of the NEPA and safety documents identify an accident whereby a spill results in loss of confinement of material and release to room, the building ventilation system if available, and potentially the environment. The spill could be initiated by an operator error, equipment failure, impacts on the material by equipment, or a severe earthquake. The MAR for this accident could range from a few grams for most glovebox accidents up to, in principle, the building inventory limit of 400 grams PuE for the Proposed Action Alternative and 38.6 grams PuE for the No Action Alternative.

The *LANL Data Call Response* (LANL 2018) indicates that while RLUOB currently operates as Radiological Laboratory, the amount of radiological material inside the gloveboxes ranges in size from milligram to near gram quantities. Some areas outside of the gloveboxes are used to store radiological material in anticipation of analysis or waste discard. Under the Proposed Action Alternative, RLUOB would operate as a Hazard Category 3 Nuclear Facility but many of the gloveboxes would still contain radiological material in the same milligram to near gram quantities, except there would be more of these gloveboxes. Also, some of the gloveboxes would contain up to tens of grams of material although the majority of the material would likely be in a metal form. Small amounts of oxide and residual amounts in solution would be present. Release mechanisms would include spills and impacts, although most of the dispersible radiological materials would be in containers and not readily spilled. Thus, for purposes of this Draft EA, it is assumed that no more than 10 percent of the building inventory is in the form of readily dispersible material (i.e., oxide). A DR of 0.1 is assumed.

Table A–5 presents a summary of airborne release fractions (ARF) and respirable fractions (RF) from DOE-HDBK-3010-94 (DOE 2013b).

Table A–5. Release Factors for Spill and Impact Accidents

Release Mechanism/Material Form	*ARF*	*RF*	*ARF × RF*	*DOE-HDBK-3010-94 Page Reference*
Spill accident, material is powder	2×10^{-3}	0.3	0.0006	4-9
Spill accident, material is metal	None	None	0	4-45
Spill accident, material is solution	2×10^{-4}	0.5	0.0001	3-33
Impact accident, material is powder	1×10^{-2}	0.2	0.002	4-87
Impact accident, material is solid	None	None	0	4-45
Impact accident, material is liquid	2×10^{-4}	0.5	0.0001	3-33

ARF = airborne release fraction; RF = respirable fraction.
Source: DOE 2013b.

Because no controls are currently planned on the form of the material to be analyzed in RLUOB (powder, liquid or solid), it is assumed for this Draft EA that the material is in the form that is most easily released and results in the largest radiological impacts. For spill accidents, the bounding release mechanisms and form of the material is powder, with an ARF of 0.002 and a RF of 0.3, for a combined ARF×RF of 0.0006.

For most spills within RLUOB, the building ventilation system are expected to continue to function after a spill or loss of glovebox containment accident, although perhaps at a degraded level, and minimize any releases to the environment. The Zone 1 building ventilation system uses two stages of HEPA filtration and is currently designated as an "item relied upon for safety."

The LPF accounts for the action of removal mechanisms (e.g., containment systems, filtration, and deposition) to reduce the amount of airborne radioactivity ultimately released to occupied spaces in the facility or to the environment. LPFs are assigned in accident scenarios involving a major failure of confinement barriers. Because this spill is not expected to threaten the integrity of the building confinement system or the HEPA filters, an LPF of 0.005 is assumed for this Draft EA.

Process or Facility-Wide Fire—All of the NEPA and safety documents identify an accident whereby a fire results in loss of confinement of the material and release to room, the building ventilation system if available, and potentially the environment. The fire could be initiated by an operator error, equipment failure, impacts on the material by equipment, or a severe earthquake. The MAR for this accident could range from a few grams for most glovebox accidents up to, in principle, the building inventory limit of 400 grams PuE for the Proposed Action Alternative and 38.6 grams PuE for the No Action Alternative. Because there are no controls on the form of the material spilled (powder, liquid or solid), it is assumed for this Draft EA that the material is in the form that is most easily released and results in the greatest radiological impacts. Release mechanisms include burning or oxidation of plutonium metal, evaporation of heated solutions, and aerosolization of oxides.

Realistically, most of the metals and dispersible radiological materials would be in containers and not subject to burning. For this Draft EA, it is assumed that no more than 10 percent of the building inventory is in a form subject to rapid oxidation (burning) or is readily dispersible material (i.e., oxide). Therefore, a DR of 0.1 is assumed.

Table A–6 presents a summary of airborne release fractions and respirable fractions for fire accidents from DOE-HDBK-3010-94 (DOE 2013b).

Table A–6. Release Factors for Fire Accidents

Release Mechanism/Material Form	***ARF***	***RF***	***ARF × RF***	***DOE-HDBK-3010-94 Page Reference***
Fire accident, material is powder	6×10^{-3}	0.01	0.000006	4-7
Fire accident, material is metal	5×10^{-4}	0.5	0.00025	4-2
Fire accident, material is solution	2×10^{-3}	1.0	0.002	3-15

ARF = airborne release fraction; RF = respirable fraction.
Source: DOE 2013b.

For fire accidents, because the dominant material type indicated in the *RLUOB Safety Design Strategy* is metal, the bounding release mechanism is burning metal, with an ARF of 0.0005 and a RF of 0.5, for a combined ARF×RF of 0.00025.

For small fires within RLUOB, the building ventilation system are expected to continue to function, although perhaps in a degraded condition. The building ventilation system is currently designated as an "item relied upon for safety." Because of the types of operations planned for RLUOB, most of the inventory is likely in the form of metal or powder. This fire are not expected to threaten the integrity of the building confinement system or the HEPA filters, so for purposes of this EA, an LPF of 0.005 is assumed.

Natural Gas Explosion—The *LANL Data Call Response* (LANL 2018) identifies a natural gas explosion as a potential accident scenario. At RLUOB, there is a natural gas line adjacent to the building and a leak of natural gas into the building and subsequent explosion could be a mechanism that results in spillage, loss of confinement, and subsequent fires. Controls including adherence to national concensus codes and standards are in place to minimize this type of accident. For this Draft EA, the radiological impacts of this accident are bounded by those from a large earthquake and fire as addressed below.

Seismic-Induced Spill and Fire—All of the NEPA and safety documents identify an accident whereby a major earthquake is an initiator of spills, impacts, and fires that result in loss of confinement of the material and release to room, the building ventilation system if available, and potentially the environment. The MAR for this accident could range from a few grams for most glovebox accidents up to, in principle, the building inventory limit of 400 grams PuE for the Proposed Action Alternative and 38.6 grams PuE for the No Action Alternative. Because there are no controls on the form of the material spilled (powder, liquid or solid), it is assumed for the purposes of this Draft EA that the material is in the form that is most easily released and results in the greatest radiological impacts. Release mechanisms include spills and impacts to oxides and liquids, burning or oxidation of plutonium metal, evaporation of heated solutions, and aerosolization of oxides due to fires.

For purposes of this Draft EA, the entire building inventory is assumed to be vulnerable to release in a seismically induced facility-wide spill and fire. In addition, the inventory is assumed to be vulnerable to release due to blasts from explosions, such as natural gas-initiated events, that might follow the earthquake. Release mechanisms include spills, blast effects, and impacts. Realistically, most of the dispersible radiological materials would be in containers and not readily spilled. For purposes of this Draft EA, it is assumed that no more than 10 percent of the building inventory is in the form of readily dispersible material (i.e. oxide). Therefore, a DR of 0.1 is assumed.

Assuming a seismic event, given that most of the materials in RLUOB will likely be in the form of metal or powder, the dominant release mechanisms are likely to be spills of powders, impacts of objects onto containers of powder, and blasts directed onto containers of powder or spilled powder. Material in the form of powder could be subject to all three mechanisms. Because of the limited combustible materials within RLUOB and the nature of activities within RLUOB, long-burning fires are not expected, even after a major earthquake that causes severe structural damage to the facility, equipment and gloveboxes within, and material storage containers.

Table A–7 presents a summary of airborne release fractions and respirable fractions for seismic accidents from DOE-HDBK-3010-94 (DOE 2013b).

Table A–7. Release Factors for Seismic Accidents

Release Mechanism/Material Form	***ARF***	***RF***	***ARF × RF***	***DOE-HDBK-3010-94 Page Reference***
Blast accident, material is powder and the material is shielded	5×10^{-3}	0.3	0.0015	4-8
Spill accident, material is powder	2×10^{-3}	0.3	0.0006	4-49
Impact accident, material is powder	1×10^{-2}	0.2	0.002	4-87
Combined Release:			0.0041	

ARF = airborne release fraction; RF = respirable fraction.
Source: DOE 2013b.

For purposes of this Draft EA, a major building collapse is assumed to occur with all of the inventory being in the form of powder which would be subject to dispersal due to seismically initiated spills, impacts, blast, and (to a lesser extent) fires. For a bounding estimate of the material that might be released to the environment, it is assumed that the material is in the form of powder, with a combined ARF×RF of 0.0041 due to combined effects of blasts, spills, and impacts.

The LPF after a seismic induced spill and fire is uncertain. The building ventilation system are not expected to function effectively during and immediately after the event. In the *SPD Supplemental EIS*, it is assumed that for new facilities and significantly upgraded facilities, the ventilation system would be designed to not fail catastrophically. A building LPF of 0.1 is assumed and expected to be conservative. This factor should adequately represent an LPF for cracks in the building or transport through rubble.

Table A–8 presents a summary of accident scenarios and source terms for RLUOB. Accident frequency ranges presented in Table A–8 are estimates based on similar accidents identified in other LANL NEPA documents (see Section A.1.6).

Table A–8. Accident Scenarios and Source Terms for RLUOB

Accident ID	*Frequency [a] (per year)*	*MAR*	*DR*	*ARF*	*RF*	*LPF*	*Release (g PuE)*
Proposed Action Alternative							
Process or Facility-Wide Spill	1×10^{-2} to 1×10^{-4} (unlikely)	400 g PuE	0.1	0.002	0.3	0.005	1.2×10^{-4}
Process or Facility-Wide Fire	1×10^{-2} to 1×10^{-4} (unlikely)	400 g PuE	0.1	0.0005	0.5	0.005	5.0×10^{-5}
Seismic-Induced Spill and Fire	1×10^{-2} to 1×10^{-4} (unlikely)	400 g PuE	0.1	ARF×RF 0.0041	1	0.1	0.016
No Action Alternative							
Process or Facility-Wide Spill	1×10^{-2} to 1×10^{-4} (unlikely)	38.6 g PuE	0.1	0.002	0.3	0.005	1.2×10^{-5}
Process or Facility-Wide Fire	1×10^{-2} to 1×10^{-4} (unlikely)	38.6 g PuE	0.1	0.0005	0.5	0.005	5.0×10^{-6}
Seismic-Induced Spill and Fire	1×10^{-2} to 1×10^{-4} (unlikely)	38.6 g PuE	0.1	ARF×RF 0.0041	1	0.1	0.0016

ARF = airborne release fraction; DR = damage ratio; LPF = leak path factor; MAR = material-at-risk; g PuE = grams plutonium-239 dose equivalent; RF = respirable fraction.

[a] Accident frequency ranges are discussed in Section A.1.6.

A.2.4 Radiological Impacts of Accidents at RLUOB under the Proposed Action and No Action Alternatives

Table A–9 presents estimated radiological doses and LCF risks for individuals and the public. These impacts are based on the estimated accidental plutonium releases presented in Table A–8. These impacts assume no emergency actions are taken to mitigate the impacts even though onsite workers are trained on actions to take as a part on routine emergency preparedness training.

A.3 Development of PF-4 Accident Scenarios for the Proposed Action and No Action Alternatives

A.3.1 Potential Accidents in PF-4

Potential severe accidents in PF-4 were evaluated in the *LANL SWEIS* (DOE 2008a) and, more recently, in the *SPD Supplemental EIS* (DOE 2015c). These analyses demonstrate that the PF-4 structure and support equipment provide substantial confinement of radionuclides. The *SPD Supplemental EIS* reflects current operating modes and includes results from TA-55 safety basis documents, including the then current Documented Safety Analysis (DSA) for PF-4.

A.3.2 Current/Existing NEPA Accident Analysis for PF-4

The *SPD Supplemental EIS* provides a detailed evaluation of accidents at PF-4, based on accidents evaluated in the PF-4 DSAs. Although many types and isotopic mixtures of plutonium and other nuclides may be present at PF-4, the PF-4 DSA is focused on weapons-grade plutonium and heat-source plutonium. For safety analysis purposes, the plutonium inventories for all types and isotopic mixtures are expressed in terms of weapons-grade plutonium equivalent which is about 93 percent plutonium-239, except for heat-source plutonium. Thus, for purposes of this Draft EA, plutonium quantities at PF-4 are expressed in terms of weapons-grade plutonium equivalents (hereafter termed plutonium). For dose estimation purposes, the releases from the evaluated accidents are presented as PuE.

Table A–9. RLUOB Radiological Accident Frequencies and Consequences

Accident ID	Accident Frequency (per year)	*Maximally Exposed Individual* [a]		*Population within 50 Miles* [b]		*Onsite Noninvolved Worker* [c]	
		Dose [d] *(rem)*	*Increased Probability of LCF* [e]	*Dose* [d] *(person-rem)*	*Additional LCF* [f]	*Dose* [d] *(rem)*	*Increased Probability of LCF* [e]
Proposed Action Alternative							
Process or Facility-Wide Spill	1×10^{-2} to 1×10^{-4} (unlikely)	2.3×10^{-6}	1×10^{-9}	2.9×10^{-4}	0 (2×10^{-7})	2.5×10^{-5}	2×10^{-8}
Process or Facility-Wide Fire	1×10^{-2} to 1×10^{-4} (unlikely)	8.9×10^{-8}	5×10^{-11}	7.6×10^{-5}	0 (5×10^{-8})	1.9×10^{-7}	1×10^{-10}
Seismic-Induced Spill and Fire	1×10^{-2} to 1×10^{-4} (unlikely)	2.9×10^{-5}	2×10^{-8}	0.025	0 (2×10^{-5})	6.3×10^{-5}	4×10^{-8}
No Action Alternative							
Process or Facility-Wide Spill	1×10^{-2} to 1×10^{-4} (unlikely)	2.2×10^{-7}	1×10^{-10}	2.8×10^{-5}	0 (2×10^{-8})	2.4×10^{-6}	1×10^{-9}
Process or Facility-Wide Fire	1×10^{-2} to 1×10^{-4} (unlikely)	8.6×10^{-9}	5×10^{-12}	7.4×10^{-6}	0 (4×10^{-9})	1.9×10^{-8}	1×10^{-11}
Seismic-Induced Spill and Fire	1×10^{-2} to 1×10^{-4} (unlikely)	2.8×10^{-6}	2×10^{-9}	0.0024	0 (1×10^{-6})	6.1×10^{-6}	4×10^{-9}

LCF = latent cancer fatality.

[a] The MEI is assumed to be on the site boundary at the point of highest estimated dose, about 1.2 kilometers from the accident location.

[b] The population doses are based on the projected 2030 population out to 50 miles from RLUOB.

[c] The doses for the onsite worker are estimated for the point of highest onsite dose assuming the worker remains in the plume for the duration of the release and does not take emergency actions as trained.

[d] Dose conversion factors for plutonium-239 are based on the EPA FGR 13 (EPA 1999a) and an assumed oxide form and "S" class.

[e] Increased risk of an LCF to an individual, assuming the accident occurs.

[f] The reported value is the projected number of LCFs in the population, assuming the accident occurs, and is therefore presented as a whole number; the calculated value is shown in parentheses. The result was calculated by multiplying the collective population dose by a risk factor of 0.0006 LCFs per rem or person-rem (DOE 2003a).

Operational accidents included a criticality, a spill involving 4,500 grams of molten plutonium, a glovebox fire involving 9,000 grams of plutonium, a vault fire involving 1,500 kilograms of plutonium, and a hydrogen deflagration involving 1,040 grams of plutonium in salts and 1,040 grams of plutonium in oxides. In addition, a design-basis earthquake with spills and fires (with degraded confinement) was evaluated assuming the entire processing (first) floor safety limit of plutonium (2,600 kilograms) was at risk and subject to spillage and fires. In the evaluation of a beyond-design-basis earthquake plus fire, a functional confinement system was not credited.

For each of the PF-4 accident scenarios evaluated in the *SPD Supplemental EIS*, conservative, bounding source-term estimates were developed as part of the LANL safety-basis to identify the controls necessary to protect the public. These source-term estimates take little, if any, credit for the integrity of containers or building confinement under severe accident conditions and assume that all containers and material-at-risk would be subject to near-worst-case conditions. The safety-basis evaluations generally assume an LPF of 1 for the unmitigated case, meaning that all of the material that is made airborne as respirable particles within the building or process enclosure is released to the environment. For the mitigated case, the LANL safety-basis analyses only take credit for the PF-4 building operating in a passive mode, with the doors open and the building confinement system and HEPA filters not functioning, and assume a lower LPF, generally 0.05.

For the *SPD Supplemental EIS*, accident source-terms were developed that present more realistic, yet conservative, estimates of potential releases from PF-4. These accident scenarios were called the SEIS Scenarios, to contrast with the Safety-Basis Scenarios. For these SEIS scenarios, the building confinement, including HEPA filters, was expected to continue functioning, although perhaps at a degraded level, during and after the accident. The scenarios use conservative ARFs and RFs from DOE Handbook 3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities* (DOE 2013b).

A.3.3 Ongoing Safety Analyses and Seismic Upgrades for PF-4

The development of safety analyses for PF-4 and safety improvements therein are summarized in the *SPD Supplemental EIS* which was issued in April 2015.

For the design-basis earthquake scenarios, the PF-4 DSAs assumed the facility remained standing and provided its credited safety containment. To better understand the potential impacts of a large, rare earthquake, LANL prepared an addendum to the DSA in 2013. The analyses in the addendum assumed a hypothetical earthquake that causes major structural damage to PF-4, including collapse of the roof onto the first floor and collapse of the first floor into the basement. It evaluated the potential releases associated with widespread spills and fires postulated to follow the earthquake. The DSA addendum was prepared specifically to address circumstances that could occur after a seismic collapse of PF-4 and a post-seismic fire. The *SPD Supplemental EIS* presents the results of a beyond design-basis earthquake with earthquake induced collapse and widespread fires based on the analysis in the DSA addendum.

As acknowledged by the Defense Nuclear Facility Safety Board, over the past decade DOE has made, and continues to make, numerous upgrades to PF-4 to improve seismic safety at PF-4 (DNFSB 2017). DOE is conducting a detailed seismic hazard analysis to develop a better understanding of the stresses on PF-4 and how it could react during a seismic event. In addition, DOE has proposed improvements to PF-4 including fire rated containers, seismically qualified fire suppression systems, and seismically qualified portions of the confinement ventilation system.

A.3.4 AC and MC Operations in PF-4 and Impacts under the Proposed Action and No Action Alternatives

The enhancement of AC and MC operations at PF-4 under both the No Action (evaluated in the *2015 CMRR SA*) and the Proposed Action Alternatives would replace past PF-4 operations that have been evaluated in PF-4 safety basis documents. For both alternatives, the proposed AC and MC operations in PF-4 would be similar to those identified in the *CMRR EIS* (DOE 2003b) and the *CMRR-NF SEIS* (DOE 2011c) as being planned for CMRR-NF. In those EISs, a range of operational accidents was considered, but controls were expected to be in place, including a hardened structure and robust confinement system, that would ensure that all operational accidents would release radioactive material to the environment only through controlled release via HEPA filters. Similar safety controls are in place at PF-4. The bounding accidents identified in both the *CMRR EIS* and *CMRR-NF SEIS* were events that might threaten the building confinement systems; these events include a facility-wide fire and seismic events of such magnitude that they could cause wide-scale spills, fires, and failure of building confinement.

Operational Accidents— For both alternatives, the proposed AC and MC operations could involve gram quantities or less of nuclear material taken from quantities of nuclear material up to several kilograms (hence the need to conduct analyses on large quantity samples in a Hazard Category 2 Nuclear Facility instead of in RLUOB). The overall inventory of AC and MC materials in PF-4 would likely be less than 10 percent of the PF-4 processing floor inventory and most of the AC and MC material would be in the form of non-dispersible metal. For AC operations, about 70 percent of the inventory would be in the form of metal; for MC operations, more than 95 percent would be metal (DOE 2015a). Potential accidents associated with the proposed AC and MC operations would not have sufficient inherent energy to aerosolize and disperse more material within a glovebox than the bounding operational accidents for PF-4 that were evaluated in the *SPD Supplemental EIS*. Those bounding operational accidents could result in airborne plutonium within a PF-4 glovebox from a spill of 4,500 grams of molten plutonium in a glovebox used for the Advanced Recovery and Integrated Extraction System project (SEIS Scenario: 0.028-gram PuE stack release), or a glovebox fire involving 9,000 grams of plutonium (SEIS Scenario: 0.024-gram PuE stack release). The *SPD Supplemental EIS* hydrogen deflagration accident from dissolution of plutonium metal was estimated to result in a stack release of 2.2 grams PuE from the SEIS Scenario (DOE 2015c, Table D-9).

The radiological impacts from bounding operational accidents were estimated in the *SPD Supplemental EIS* to result in doses of up to 0.11 rem to an individual at the site boundary and up to 26 person-rem to the population within 50 miles (with no LCFs expected) (DOE 2015c, Table D-18). Changes in the PF-4 DSAs between 2011 and 2015 would not change this result. Any operational accident involving the proposed AC and MC activities are not expected to result in larger potential releases to the environment than these bounding *SPD Supplemental EIS* operational accidents.

Seismically Initiated Accidents—For both alternatives, the proposed AC and MC operations are not expected to increase source terms or material releases from PF-4 compared to any of the seismically initiated accidents evaluated for this facility in the *SPD Supplemental EIS*. The new AC and MC operations would replace existing plutonium activities evaluated in current safety basis documents and the *SPD Supplemental EIS* PF-4 accident analysis. The total building plutonium inventory associated with the additional AC and MC operations would represent a small fraction of current building inventories. For the design-basis earthquake with spill and fire evaluated in the *SPD Supplemental EIS*, the entire processing (first) floor safety limit of plutonium (2,600 kilograms) was at risk and subject to spillage and fires. With the replacement of some activities evaluated in the *SPD Supplemental EIS* with the AC and MC operations proposed in this SA, these material limits would not change. In fact, the material-at-risk associated with the proposed AC and MC operations would be lower than that in gloveboxes and PF-4 rooms as currently evaluated. The forms of the materials associated with the AC and MC operations are not expected to be more vulnerable to large-scale aerosolization in seismic spills and fire accidents than those evaluated in the *SPD Supplemental EIS*. Thus, the impacts from seismically initiated accidents involving the proposed AC and MC operations in PF-4 would be bounded by the impacts evaluated in the *SPD Supplemental EIS*, and the contribution of AC and MC operations to these impacts would be small. For the design-basis earthquake with spill plus fire, the release to the environment was estimated for the SEIS Scenario to be 3.8 to 6.0 grams PuE, depending on the alternative addressed in the *SPD Supplemental EIS* (DOE 2015c).

The radiological impacts from the design-basis earthquake with spill plus fire accident was estimated in the *SPD Supplemental EIS* to result in doses of up to 0.19 to 0.30 rem to an individual at the site boundary and up to 71 person-rem to the population within 50 miles (with no LCFs expected) (DOE 2015c, Table D-18). Changes in the PF-4 DSA between 2011 and 2014 would result in a slight reduction in these doses.

For the beyond-design-basis earthquake with spill plus fire, the most recent analysis of potential releases to the environment is in the DSA addendum that was reported in the *SPD Supplemental EIS*. That analysis evaluates the potential radiological impacts of an earthquake so severe that it would cause major structural damage to the heavily reinforced PF-4. The earthquake was assumed to damage the internal structures causing the collapse of the roof onto the first floor and collapse of the first floor into the basement. The analysis assumes that radioactive materials within PF-4 would spill and be impacted by falling structural components, and that a major, facility-wide fire would ensue. The assumed extent of damage is highly unlikely even in an earthquake with ground motion much higher than that of the design-basis earthquake. Although there could be a substantial release of radioactive material following such an earthquake accompanied by a facility-wide fire, loss of life within the facility and within the region due to seismic damage would be the predominant impact of such an earthquake.

The more realistic case provided in the *SPD Supplemental EIS* (SEIS Scenario) is conservative and likely over-estimates the potential releases, but uses more realistic parameters. That case makes differing assumptions depending on the location and type of MAR, but considers a DR of 0.1 for the oxide and metal from spills and fires and 0.5 from impacts on both the main floor and basement of PF-4. For some of the other more volatile materials, DRs of 1 are assumed. Because a wide range of materials were assumed to be vulnerable to spills, impacts from falling debris, and long-burning external fires, median or average ARFs and RFs from DOE Handbook 3010-94 (DOE 2013b) were assumed. Extremely high LPFs were also assumed. For releases due to spills, an LPF of 0.3 was assumed. For releases due to impacts and fires, an LPF of 0.5 was assumed. Estimated releases to the atmosphere for this case are 321 grams (11 ounces) of plutonium-239 equivalent under an *SPD Supplemental EIS* alternative whereby 2 metric tons of plutonium would be processed at PF-4, and 362 grams PuE under an *SPD Supplemental EIS* alternative whereby 35 metric tons of plutonium would be processed at PF-4 (DOE 2015c, Table D-9). Of these releases, materials associated with the Surplus Plutonium Disposition Program would account for approximately 18 percent of the release under the lower throughput case and 32 percent under the higher throughput case.

The radiological impacts from the beyond design-basis earthquake with spill plus fire accident was estimated in the *SPD Supplemental EIS* to result in doses of 16 to 18 rem to an individual at the site boundary and up to 4,300 person-rem the population within 50 miles (with the possibility of up to 3 LCF) (DOE 2015c, Table D-18).

Because the material inventories associated with AC and MC operations are primarily in non-dispersible metal forms, represent less than 10 percent of the overall building inventories, and would not increase the facility MAR, they would not appreciably add to the source term of earthquake-initiated accidents. Consequently, the impacts from the bounding accidents in the *SPD Supplemental EIS* or current PF-4 safety documents would not be affected by AC and MC operations under either EA alternative.

A.4 Combined Accident Implications for the Proposed Action and No Action Alternatives

With implementation of the either the Proposed Action or the No-Action Alternative evaluated in this Draft EA, the accident risks associated with nuclear operations in the TA-55 area would change, but those changes would be small. Those accident risks include those for PF-4 and RLUOB as well as support operations including radioactive management activities in TA-54. In addition, the accident risks associated with ongoing AC and MC operations in the CMR Building and transfer of nuclear material between the CMR Building in TA-3 and TA-55 facilities would be eliminated. Overall, moving AC and MC operations from the CMR Building to a modern or upgraded facility is expected to lower the accident risks associated with the AC and MC operations.

The increment to accident risk in the TA-55 area would be small. Bounding operational accidents at PF-4 assuming existing operations are projected to release 0.024 to 2.2 grams PuE to the environment (DOE 2015c, Table D-9). As indicated in Section A.3.4, replacement of activities in rooms and gloveboxes with the AC and MC operations evaluated in this Draft EA would not result in larger potential releases from these bounding operational accidents. As shown in Table A–8, bounding operational accidents (process or facility-wide spill or fire) in RLUOB under the Proposed Action Alternative would release 5.0×10^{-5} to 1.2×10^{-4} grams PuE to the environment. The bounding operational release from RLUOB (1.2×10^{-4} grams) would represent 0.005 to 0.5 percent of the bounding operational accident release from PF-4. More realistically, many of the safety controls including building ventilation systems likely would to continue to function during most operational accidents in RLUOB under both the Proposed Action and No Action alternatives.

Assuming a very severe seismic event causing wide-scale spills and fires within PF-4, with or without the proposed AC and MC operations, releases of 3.8 to 6.0 grams PuE were estimated for the design-basis earthquake with spill plus fire while releases of 321 to 362 grams PuE were estimated for the beyond-design basis earthquake with spill plus fire (see Section A.3.4). As shown in Table A–8, the bounding seismic release from RLUOB assuming the proposed AC and MC operations is 0.016 and 0.0016 grams PuE under the Proposed Action and No Action Alternatives, respectively. Thus, with the addition of AC and MC operations to PF-4 and RLUOB, the combined accident releases and corresponding impacts would be 0.3 to 0.4 percent larger under the Proposed Action Alternative than those from PF-4 alone, assuming a design-basis earthquake, and 0.03 to 0.04 percent larger than those from PF-4 alone under the No Action Alternative. Combined accident releases assuming a beyond design-basis earthquake would be almost entirely attributable to releases from PF-4. The differences in releases from PF-4 are primarily due to the assumption in the *SPD Supplemental EIS* that the building ventilation system in PF-4 would continue to function during a design-basis earthquake with a leak path factor of 0.005 for plutonium.

Under both the Proposed Action and No Action Alternatives, the accident risks associated with continued AC and MC operations at the CMR Building would be eliminated; these risks are evaluated in the *CMRR EIS* (DOE 2003b) and *CMRR-NF SEIS* (DOE 2011c).

The radioactive waste from the room and enclosure changes in PF-4 and from new AC and MC operations in PF-4 and RLUOB would not introduce new types of hazards to ongoing waste management activities in TA-54. Similar types of TRU waste, LLW, and MLLW are routinely handled in TA-54. Waste volumes associated with the upgrades to PF-4 and RLUOB and AC and MC activities are very small relative to ongoing waste volumes as indicated in Chapter 4, Section 4.3, of this EA. These additional waste volumes are not expected to substantially change accident probabilities and would be well within historical waste volumes handled at TA-54. Under either EA alternative, the radioactive waste associated with TA-55 facility modifications and AC and MC operations would not substantially change the overall radioactive waste accident risks at TA-54.

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APPENDIX B
NATIONAL ENVIRONMETAL POLICY ACT ANALYSES INCORPORATED BY REFERENCE

The analyses in this environmental assessment (EA) depend in part on other analyses prepared by the U.S. Department of Energy (DOE) under the National Environmental Policy Act (NEPA). These other NEPA analyses, listed below, are incorporated by reference into this EA:

Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, DOE/EIS-0350, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, November 2003.

Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico, DOE/EIS-0380, National Nuclear Security Administration, Los Alamos Site Office, Los Alamos, New Mexico, May 2008.

Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, DOE/EIS-0350-S1, Los Alamos, New Mexico, August 2011.

Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Supplement Analysis, DOE/EIS-0350-SA-2, Los Alamos, New Mexico, January 2015.

Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement, DOE/EIS-0283-S2, Office of Fissile Materials Disposition and Office of Environmental Management, Washington, DC, April 2015.

Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste, DOE/EIS-0375, Office of Environmental Management, Washington, DC, January 2016.

Draft Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory, DOE/EIS-0402, Office of Environmental Management, Simi Valley, California, January 2017.