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Author(s):	Holtkamp, David M. Wong, Amy Suwu
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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

David Holtkamp, EPC-ES

Amy Wong, C-DO

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Los Alamos National Laboratory EST. 1943

NNSA National Nuclear Security Administration

Illustration:

Front Cover – Aerial view of CMRR project site (2015)

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Introduction

The Department of Energy/National Nuclear Security Administration (DOE/NNSA) is proposing to make an administrative change to the Radiological Laboratory/Utility/Office Building (RLUOB). The Proposed Action is to recategorize RLUOB from its current status of radiological facility to a material-at-risk (MAR) limited Hazard Category 3 Nuclear facility.

In accordance with Council on Environmental Quality (CEQ) and DOE requirements, the analysis in the Environmental Assessment focuses on determining whether recategorizing the RLUOB from a radiological facility, with a limit of 38.6g of plutonium equivalent material (PuE), to a 400g PuE material-at-risk-limited Hazard Category 3 Nuclear facility requires preparation of an Environmental Impact Statement (EIS), or whether NNSA can issue a Finding of No Significant Impact (FONSI) for the Proposed Action.

This report provides data for incorporation into the Environmental Assessment being prepared under contract to the U.S. Army Corps of Engineers. Responding to the data call requires several areas of expertise. Los Alamos National Laboratory (LANL) subject matter experts estimate equipment lists, facility modifications, waste quantities, labor needs, and radiological doses. LANL National Environmental Policy Act (NEPA) experts assisted the contractor in compiling existing data from the *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (SWEIS) (DOE/EIS-0380) and 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) and supporting documents for public and other impacts. Bounding conditions are used to determine NEPA estimates.

Much information in this document is copied or extrapolated from the *Data Call Response for NEPA Supplement Analysis of CMRR,* February 1, 2015 (rev. 1), LA-UR-14-29623 (SA Data Call Response). The SA Data Call Response supports the NEPA analysis for installing analytical chemistry and materials characterization capability in RLUOB and the Plutonium Facility (PF-4) following mission need, programmatic, and technical changes that allowed an increase from 8.4 grams PuE to 38.6 grams PuE in a radiological facility.

Description of RLUOB

RLUOB (building TA-55-0400) was completed in 2011. The building combines office space for 350 workers with 19,500 square feet (sf) of radiological laboratory space, plus a Central Utilities Building (CUB). Many of its features and equipment were specified to support the (now cancelled) Chemistry and Metallurgy Research Replacement-Nuclear Facility (CMRR-NF), making RLUOB a "radiological-plus" building. To provide lessons-learned for constructing CMRR-NF, RLUOB was built with a focus on the Nuclear Quality Assurance standard (NQA-1) that is only required for Hazard Category 3 or higher buildings. For example, the CUB was built to supply utilities for RLUOB and non-safety systems in the CMRR-NF, which leads to excess capacity for a radiological facility.

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), while the remainder of the facility meets the requirements of seismic Performance Category 1. The office portion of RLUOB is classified as Type 1A/International Organization for Standardization (ISO) Class 6 (Fire Resistive Construction) under the International Building Code (IBC). The RLUOB 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. Institutional requirements are compliant with the LANL Engineering Standards Manual PD-342 (see Section 5, Table II-7, of the manual) and the IBC.

Because RLUOB is a multi-purpose facility, it has its own heating, ventilation, and air-conditioning (HVAC) system to support office occupancy, and a separate laboratory HVAC system to support laboratory operations. The HVAC 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 2 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 the fume hoods and open-front box 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, 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 the hoods and open-front boxes in the laboratory, the laboratory room, and laboratory support rooms. The Zone 2 exhaust system also is mounted in the basement area and has a certified HEPA filtration system with fire protection and 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 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.

The laboratories where 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 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.

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 system, 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).

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

RLUOB was designed to provide utilities to both RLUOB and the cancelled CMRR-NF. Electric power, water, heat, compressed air, backup power, and other services are provided by utility equipment housed in the physically separate (for fire protection) Central Utility Building portion of RLUOB. 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.

Description of Proposed Action

The proposed action is to recategorize RLUOB from its current status as a radiological facility to a MAR-limited Hazard Category 3 Nuclear facility. The Hazard Category 3 RLUOB would have a MAR limit of 400g PuE. The higher MAR limit would allow additional analytical chemistry capabilities that were slated for PF-4 to be installed in three empty RLUOB laboratory rooms instead, along with some minor repurposing of some gloveboxes and relocation of some instruments. With this Proposed Action, the need to install some new gloveboxes and programmatic equipment for analytical chemistry in PF-4 would be eliminated.

Correspondingly, predecessor activities like relocating existing PF-4 programmatic operations to other rooms at PF-4 and decontaminating and decommissioning some equipment would not have to happen. Installation of equipment in RLUOB would provide additional capability in RLUOB for low-hazard analytical chemistry (AC). In addition, low-hazard AC activities would not be installed in the more expensive space in PF-4. Also, fewer enclosures would be D&D’ed from PF-4, reducing worker exposure and the quantity of transuranic, mixed, and low-level radioactive waste generated by the CMRR Project.

NNSA requested that LANL analyzed the potential safety impacts associated with increasing the allowable building inventory in RLUOB to 400 grams PuE.[1] The analysis determined that with a limit of 400 grams PuE, the maximum reasonably foreseeable accident is not expected to result in unmitigated public and noninvolved worker radiological doses greater than regulatory limits (1 rem and 5 rem, respectively); therefore, no facility structures, systems, and components would need to be designated safety class or safety significant. The analysis also determined that the inventory would not exceed the 400-gram threshold quantity for Security Category III levels of plutonium, so no perimeter intrusion,

[1] DOE (U.S. Department of Energy), 2014, memorandum, D.L. Cook, National Nuclear Security Administration, Deputy Administrator for Defense Programs, to K. Lebak, Manager, Los Alamos Field Office, and C. McMillan, Director, Los Alamos National Laboratory, *Program Secretarial Officer (PSO) Request for Analysis of a Design Option for the Chemistry and Metallurgy Research Replacement (CMRR) Project*, October 16.

detection, assessment, and delay system (PIDADS) would be required. Finally, the analysis concluded that 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.

Description of Modifications in PF-4 and RLUOB

Projects analyzed in the *Chemistry and Metallurgy Research Building Replacement at Los Alamos National Laboratory, Los Alamos, New Mexico Supplement Analysis* (Supplement Analysis) (DOE/EIS-0350-SA-2) describe removing existing contaminated equipment and installing new equipment in PF-4; the modified space was estimated to be approximately 7,000 square feet. New equipment was also to be installed in empty laboratory space in RLUOB; the modified space was estimated to be approximately 10,000 square feet. Under this Proposed Action, some of the low-hazard analytical chemistry activities would be installed in RLUOB instead of in PF-4; DOE/NNSA would remove less contaminated equipment from PF-4 and install more equipment in RLUOB than the Supplement Analysis describes. This decreases the amount of space modified in PF-4 to 5,400 square feet and increases the amount of space modified in RLUOB to 13,000 square feet.

Modification and refitting of RLUOB under the No Action Alternative of the Supplement Analysis (DOE/EIS-0350-SA-2) is underway and is scheduled to be completed in approximately 3 to 5 years. The second and final phase would install additional AC and MC capabilities at RLUOB that were slated for PF-4. These capabilities include: 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. The second phase would be completed in approximately 4 to 7 years, subject to funding.[2]

Table 1 shows the enclosure removal/modification/addition differences between the Proposed Action and No Action Alternatives. The No Action Alternative is simply the project description as analyzed in the Supplement Analysis.

Table 1: Comparison of Equipment Removal and Installation for the Proposed Action and No Action Alternatives

Ventilated Enclosures	**Proposed Action Alternative**	**No Action Alternative**
Removed from PF-4	41	55
Modified in PF-4	29	30
Installed in PF-4	30	43
Installed In RLUOB	109	81
Total removed, modified, or installed in both	209	209
Total removed, modified, or installed in PF-4	100	128
Total Installed in both	139	124
Total modified or installed in both	168	154

Consistent with methodology used in the Supplement Analysis, for the total number of new and ventilated enclosures a factor of 10 percent is applied to the Conceptual Design Report (CDR) numbers.[3]

[2] Amy Wong (C-DO) and David M. Holtkamp (EPC-ES), personal communication May 31, 2017.
[3] Steven Booth (AET-2) and Liz English (EPC-ES), personal communication, February 7, 2017.

Construction Time Horizon

The estimated timeline for construction and modification of PF-4 and RLUOB as described in the Proposed Action Alternative is 7 to 9 years subject to funding: PF-4 (7 years) and RLUOB (7 to 9 years; with the second phase of 4 to 7 years). The No Action Alternative estimates that modifications to both facilities would require 8 to 10 years.[4]

Air-Polluting Equipment Required for Construction

New operational equipment will be delivered by trucks that will have nominal air emissions. Once within the HEPA-protected environments inside PF-4 and RLUOB, electric-powered tools and forklifts will be used, and no criterial air pollutant emissions will occur.

Socioeconomics

Impacts to Construction Workers

A combination of resident TA-55 technicians, LANL crafts and subcontract workers, and technical experts will D&D and install equipment. Security escorts will be required to support construction activities. The count of workers excludes current PF-4 and RLUOB workers that would provide ancillary support to the project such as radiological control technicians (RCTs). That is, only workers who are assigned directly to the project are counted. The assumption is that LANS staff are currently fully obligated on other existing projects, meaning that full-time equivalent (FTEs) for these projects must be considered “new” staff resources to the LANL site. Subcontract employees are also additions to the LANL site.[5]

Overall, there would be a small decrease in the number of construction workers at PF-4 under the Proposed Action versus the No Action alternative. This is because D&D and installation work requires many people, and LANL maintains the two-person rule at PF-4. RLUOB is a clean installation, but involves the use of more space for installing the equipment.[6]

Impacts to construction workers under the Proposed Action Alternative are similar to impacts under the No Action alternative, with the difference being that less equipment would be removed from PF-4 under the Proposed Action alternative. With less equipment being removed from the contaminated PF-4, there would be less worker radiological exposure.

During D&D projects workers will be removing an existing glovebox and minimal room equipment. Although there will be contamination, no special nuclear material will be present. Consequently, these activities will provide a dose similar to the background dose for all PF-4 workers. RLUOB construction activities for the Proposed Action will not result in significant worker exposures. After the systems are installed and tested there will be two final “hot” connections per lab module, where new clean lines are tied-in to existing radiological lines. Connections will require removing the existing end piece and installing a small piece of duct and a small piece of pipe. The likelihood is these facility utilities will not be “hot” due to the amount of materials present in RLUOB, but for NEPA we consider them as such.[7]

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[4] *Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Supplement Analysis*. (DOE/EIS-0350-SA-2), January 2015.
[5] Data Call Response for NEPA Supplement Analysis of CMRR, AET-2, February 1, 2015 (rev. 1), LA-UR-14-29623.
[6] Amy Wong (C-DO) and Liz English (EPC-ES), personal communication, January 26, 2017.
[7] Data Call Response for NEPA Supplement Analysis of CMRR, AET-2, February 1, 2015 (rev. 1), LA-UR-14-29623, Note 9.

The assumption for the radiation workers during the peak construction is approximately 150 FTEs for both the No Action and Proposed Alternatives.

Impacts to Operational Workers

Under both the Proposed Action and No Action Alternatives, approximately 30 new FTE staff hires to work in both PF-4 and RLUOB. These hires would support AC and MC activities at both facilities.[8] The No Action Alternative estimates 100 radiation workers would be needed at RLUOB and 60 would be at PF-4. The Proposed Action Alternative estimates 135 radiation workers at RLUOB and 48 radiation workers at PF-4.[9]

Waste Management

Construction Waste

The Proposed Action Alternative would generate less construction waste than the No Action Alternative because less equipment would be removed from PF-4 (see Table 1). All construction waste at RLUOB will be non-radiological with the exception of the final radiological hook-ups ("hot tie-ins") to complete the projects. There will be six tie-ins which will create some material waste, plus personal protective equipment for construction workers. A total of about 105 cubic feet of LLW from RLUOB is expected under the Proposed Action Alternative, and a similar amount is assumed under the No Action Alternative.[10] Typical non-radiological construction debris will consist of wooden crates and boxes, metal pipe pieces, etc. Waste will be segregated for recycling and disposal.

Construction waste at PF-4 would be from removing or modifying an enclosure and its associated equipment. This waste would consist of transuranic, mixed low level, and low level radioactive waste. Capabilities in TA-54 would be used to process enclosures and other equipment removed from PF-4 modifications to reduce waste volumes and to separate transuranic (TRU) waste from low level radioactive waste (LLW) and mixed LLW. Table 2 shows waste quantities estimated to be generated from the Proposed Action and No Action Alternatives.

Table 2: Waste Generation Comparison between the Proposed Action and the No Action Alternatives (cubic feet)

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

Solid Radioactive Wastes

TRU waste characterization capabilities have been installed at TA-55 or are planned for 2017, including nondestructive analysis, flammable gas testing, and visual examination equipment, and real-time

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[8] Section 4.1.10 Socioeconomics, *Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Supplement Analysis*. (DOE/EIS-0350-SA-2), January 2015, p. 21 through 22.

[9] Amy Wong (C-DO) and David M. Holtkamp (EPC-ES), personal communication May 31, 2017.

[10] Section 4.4 Waste Management, *Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Supplement Analysis*. (DOE/EIS-0350-SA-2), January 2015, p. 35 through 38; CMRR Project Waste Management Plan, CMRR-PLAN-00011, R1, Effective Date March 21, 2016.

radiography. Also planned for 2017 is a capability in TA-55 to load TRU waste containers into Transuranic Pack Transporter (TRUPACT) packaging for shipment to the Waste Isolation Pilot Plant (WIPP). Additionally, the recertification of LANL's TRU waste characterization program was recertified in 2017 per the WIPP waste acceptance criteria (WAC)[11] issued in June 2016.

Additional storage areas have been designated at TA-55 for TRU waste storage both inside and outside of PF-4. In addition, TRU waste containers are now being stacked two high in locations where it is physically possible and authorized. With additional storage areas and two high stacking, the drum storage capacity at TA-55 has been increased from 400 to 1,200 55-gallon drum-equivalents.[12] 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. When the TRU Waste Facility (TWF) is authorized to startup, TRU waste inventory from TA-55 will be transported to the TWF. TRU waste containers will then be packaged into TRUPACT packaging for shipment to WIPP. TRUPACT loading operations may occur at TA-55, the TWF in TA-63, or at the Radioassay Nondestructive Testing (RANT) Facility in TA-54.

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. Disposal of LLW in TA-54 is currently paused, but may resume in the future for some waste. 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.

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.[13]

Waste Water

The Radioactive Liquid Waste Treatment Facility (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 were installed. A replacement for the RLWTF LLW treatment system is currently under construction. This new system will include an evaporation unit to eliminate liquid discharges into the environment.[14]

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[11] Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Project, DOE/WIPP-02-3122, Rev. 7.4, Effective Date: April 22, 2013.

[12] CMRR Project Waste Management Plan, CMRR-PLAN-00011, R1, Effective Date March 21, 2016.

[13] Section 3.2.10 Waste Management, *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*, (DOE/EIS-0283-S2), p. 3-100 through 3-105.

[14] Section 3.2.10.3 Low-Level Radioactive Waste, *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*, (DOE/EIS-0283-S2), p. 3-104.

Operations

Air Quality Emissions

There would be reduced AC and MC operations at RLUOB and PF-4, thus resulting in reduced emissions.[15] Future AC and MC operations would likely not involve processing krypton or xenon, but that samples containing trace levels of these elements could be tested.

Based on the CMRR EIS[16], Table 3 shows estimated emissions for the Proposed Action Alternative from operating a new CMRR facility.

Table 3: Estimated Emissions for Operating a New CMRR Facility

Emission Material	**Curies/year**
Actinides (modeled as Pu-239	7.6E-4 Ci
Krypton-85	100 Ci
Xenon-131m	45 Ci
Xenon-133	1,500 Ci
Tritium*	1,000 Ci

* = Tritium release is estimated for H-3 (water vapor) = 750 Ci/year and H-3 (elemental) = 250 Ci/year.[17]

For PF-4 there is no impact to current overall emissions due to AC/MC activities. A majority of MC and some AC activities already take place in PF-4. The amount of nuclear materials used by AC activities is minimal compared to the rest of PF-4 activities. Currently most of materials going to the existing CMR facility originate from PF-4. In PF-4, no new tritium capabilities are planned as part of CMRR PEI project, and any tritium associated with MC/AC activities will be well within the existing PF-4 limit. Fission products will have no emissions impacts for PF-4.

In RLUOB only small amounts of tritium-contaminated samples (not pure tritium) will be handled. RLUOB is approved for implementation of SD G 1027 with a limit of 38.6 grams of Pu-239 equivalent, with an annual throughput cap at three kilograms of Pu239-equivalent. The CMRR AC and MC activities under the Proposed Action will work within this analysis.[18]

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[15] *Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Supplement Analysis,* (DOE/EIS-0350-SA-2), January, 2015.

[16] Table 2.2 Operational Characteristics of the CMRR Facility per year, *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory*, *Los Alamos, New Mexico* (CMR EIS) (DOE/EIS-0350). P. 2-26.

[17] Table 4-7 No Action Alternative – 2004 CMRR-NF and RLUOB Radiological Emissions During Normal Operations. *Final 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), August, 2011, p. 4-13; Table 6. Comparison of Radiological Impacts to Members of the Public under the CMRR EIS and this SA, *Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Supplement Analysis,* (DOE/EIS-0350-SA-2), January, 2015, p. 26.

[18] Amy Wong (C-DO) and David Fuehne (EPC-CP) emails, September 29, 2014.

Operational Waste

Annual waste generated from operation in RLUOB and PF-4 is the same for both the Proposed Action and No Action Alternatives. It is 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.[19]

- TRU waste = 2,370 cubic feet/year
- LLW = 71,820 cubic feet/year
- MLLW = 700 cubic feet/year
- Hazardous waste = 24,700 pounds/year
- Sanitary waste[20] = 390,000 gallons/year

Hazard Identification and Material-at-Risk for RLUOB

In the hazard identification process, the physical consequences are screened as standard industrial hazards; the radiological consequences are considered in the hazard evaluation.

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

- Fire within the building, a room, or a glovebox
- Explosions due to over-pressurizations
- 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, wild land fire, airplane crash, or vehicle impact
- Natural phenomenon including high wind, earthquake, and lightning strike

An evaluation of the hazards identified occurs through a hazard analysis process which shows low consequences if a hazardous accident occurs. A nature of process analysis of the processes in RLUOB is being developed to preclude a criticality hazard. A summary of the nuclear hazards based on the expected operations is presented in Table 4 below.

[19] Section 4.4.2 Operation Waste, *Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico, Supplement Analysis,* (DOE/EIS-0350-SA-2), January, 2015, p. 38.

[20] The original rates of sanitary waste projected for CMRR Facility was 7.2 million gallons. Table 4-12 No Action Alternative – Operational Waste Generated Rates Projected for CMRR Facility and Los Alamos National Laboratory Activities, *Final 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), August 2011, p. 4-23.

Table 4. Summary of Nuclear Hazards.

Hazard Description	Amount/Units	Form
PuE MAR limit for facility	400 g PuE total	Oxides, solutions, metals, powders, salts
Fissile Limit	400 g of Pu-239 500 g of U-233 700 g of U-235	Any form
Breakdown of Hazards		
PuBe	< 5 g and < 10 mR/h	Powder, metals
Am-241	< 1 g and < 50 mR/h	Solution, powder
Tritium contaminated parts or small samples	< 1 g tritium	Adhered to parts or small amounts of gas
U-233	Small gram quantities per process location are typical, and 2-L containers per process location; less than 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-L 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-L containers per process location	Oxides, liquids, metals, powders, salts, residue solutions

The largest chemical hazards as a fraction of the DOE protective action criteria (PAC) (<10% of PAC) is presented in Table 5 below. No chemical inventory exceeds the PAC for either the co-located worker or the public, and the chemical hazard is classified as low.

Table 5. Summary of Chemical Hazards.

Chemical	Predicted Annual Facility Inventory (lb)	Noninvolved (Co-Located) Worker Impact Assessment at 100 m		Public Impact Assessment at 1 km	
		PAC-3 Limit (lb)	Fraction of PAC-3 Limit	PAC-2 Limit (lb)	Fraction of PAC-2 Limit
Ammonium hydroxide (as NH_3)	20	1.85E+02	1.08E-01	8.49E+02	2.35E-02
Argon (cryogenic)	41,100	1.01+05	4.05-01	1.85E+06	2.22-02
Bromine	20	4.85E+01	4.12E-01	4.38E+01	4.57E-01
Carbon monoxide	50	5.85E+01	8.55E-01	4.70E+02	1.06E-01
Hydrochloric acid	50	5.49E+01	9.11E-01	3.87E+03	1.29E-01
Hydrogen bromic (Hydrobromic acid)	15	6.12E+01	2.45E-01	4.08E+02	3.67E-02
Hydrogen fluoride (Hydrofluoric acid)	50	3.35E+02	1.49E-01	5.84E+03	8.57E-03
Nitric acid (> 94.5)	500	8.03E+02	6.23E-01	6.70E+03	7.46E-02
Nitric oxide	3	3.79E+00	7.92E-01	7.26E+01	4.13E-02
Nitrogen (cryogenic)	16,000	1.54E+05	1.04E-01	4.73E+06	9.73E-04
Nitrogen dioxide	5	5.82E+00	8.59E-01	1.12E+02	4.48E-02
Sodium hydroxide	100	7.73E+02	1.29E-01	2.47E+04	4.05E-03

Chemical exposure from actual handling by the facility worker is considered a standard industrial hazard per the guidance in DOE-STD-3009-2014, Section A-2. The remainder of the hazard analysis focuses on consequences as a result of the radiological hazards.

The table below lists two proposed controls for the Hazard Category 3 RLUOB. The 400 g PuE MAR control protects the assumptions of the initial condition; the 100 g PuE MAR control results in low dose consequences to the facility worker based on back-of-the source term calculations for all of the hazard scenario types.

Controls	Safety Function
Building MAR Limit = 400 g PuE	Initial condition; protects assumptions of the analysis for low radiological dose consequences to all receptors
Laboratory Room MAR Limit = 100 g PuE	Mitigates dose consequences due to facility worker

The currently RLUOB facility, operating as a less than Hazard Category 3 Nuclear facility, has already implemented several controls as follows:

- Glovebox or hood
- Glovebox heat detection
- Facility ventilation systems
- Air monitors
- Fire suppression system

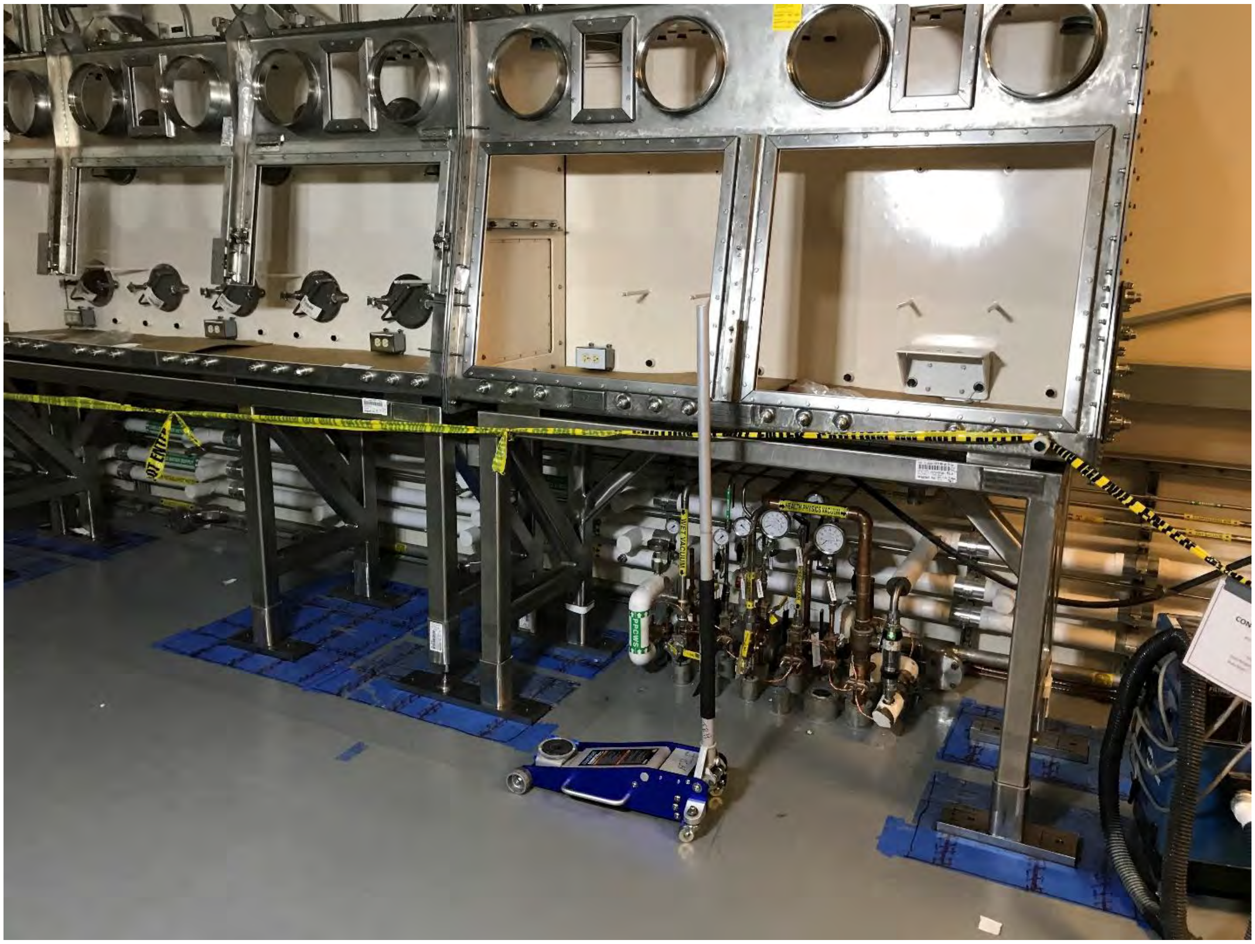
- Fire detection and paging system
- Fire barriers
- Limits on combustibles

In the Hazard Category 3 documented safety analysis, some of these controls may be selected as providing defense-in-depth.

Pictures of CMRR Project Site

CMRR Project Site (2017)

RLUOB site with Construction Access, Breakroom and Staging Area (2017)



Installation of Ventilated Enclosure and Utilities for Analytical Chemistry Analysis in RLUOB (2017)